Engineering Library
OCT 6 - 1931

Compressed Air Magazine

Vol. XXXVI, No. X London New York Paris 35 Cents a Copy

OCTOBER, 1931

CIRCULATION THIS ISSUE
28,842 *COPIES*

Fairchild from Keystone

GIANT SEAPLANE "DO-X" ARRIVING IN NEW YORK HARBOR ON AUGUST TWENTY-SEVENTH CARRYING A TOTAL OF SEVENTY-TWO PERSONS

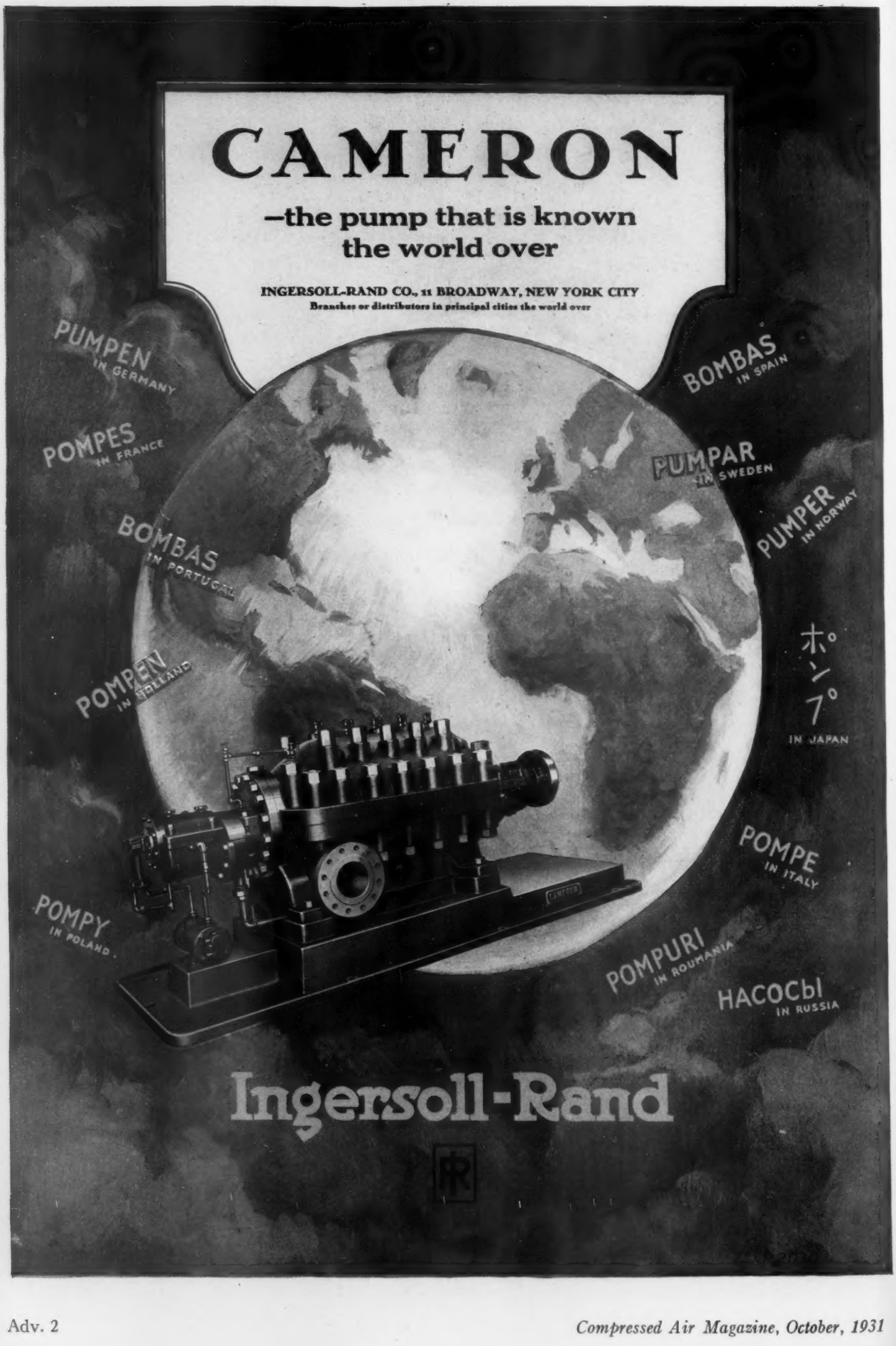
Santiago de Cuba Engaged on Big Water-Works Project
E. I. Montoulieu

Progress in the Drilling of Subaqueous Rock
C. C. Hansen

Rio Grande to Irrigate Larger Area in Maverick County
R. G. Skerrett

Aircraft Aid Mineral Survey of Barren Lands
W. M. Goodwin

(TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 22)


CAMERON
–the pump that is known the world over
INGERSOLL-RAND CO., 11 BROADWAY, NEW YORK CITY
Branches or distributors in principal cities the world over
PUMPEN IN GERMANY
POMPES IN FRANCE
BOMBAS IN PORTUGAL
POMPEN IN HOLLAND
POMPY IN POLAND
BOMBAS IN SPAIN
PUMPAR IN SWEDEN
PUMPER IN NORWAY
ポンプ IN JAPAN
POMPE IN ITALY
POMPURI IN ROUMANIA
НАСОСЫ IN RUSSIA
Ingersoll-Rand

As It Seems To Us

OUR FIRST FAMILIES

THERE is a widespread belief that the socially elect of the land reached the Continent of North America from Europe; and those that can point back a couple of hundred years are more or less puffed up over their right of precedence. As a matter of fact, all the gentry of that origin are just newcomers considered in terms of length of residence and priority of possession.

According to so eminent an authority as Dr. ALES HRDLICKA, curator of anthropology at the Smithsonian Institution, the first families to reach the continent migrated from Asia, landing in Alaska and traveling thence down the west coast from which they penetrated to the interior by following the courses of rivers. Doctor HRDLICKA has recently returned from an expedition to Alaska that had for its purpose the discovery, if possible, of evidences that might confirm the belief that the original human inhabitants of the continent were of an Asiatic race.

Many things have led to the assumption that the American Indians reached our shores from that source; but no traces have been discovered of the exact route followed by the aborigines. However, the expedition has made finds that offer convincing proof that the earliest people on the continent arrived by the coast and peninsula passage—that is, that they did not primarily filter inland and work their way southward across swift rivers and high mountains. To follow along the peninsula and to advance southward parallel with the coast was the likeliest and the safest route. As explained by Doctor HRDLICKA: "Actual investigations, by placing oneself much in the physical position of the primitive wanderer", have shown any other course to have been prohibitively hazardous under the conditions prevailing in the dim past.

The researches carried out under the auspices of the Smithsonian Institution have covered the past three summers; and they have revealed specimens of various sorts that add so much more testimony to the progress of early man southward via Alaska. We are informed by the *United States Daily* that skeletal remains and other objects of great significance have opened a new and more scientific era in this field of American exploration.

Not until those remote migrating people arrived far enough south to justify fairly permanent settlements did they leave behind them much in the way of lasting evidence of the routes traced by them; and probably their points of contact with the continent in the earliest stages of their onward march may never be established unless mere accident brings them to light. Furthermore, the many changes that have taken place along the coast in the intervening ages have probably obliterated the indications of their temporary occupation during their long trek southward to favorable localities. We look forward with interest to the publication of Doctor HRDLICKA'S full report.

WHY PETAIN IS COMING

OFFICIALLY, Marshal HENRI PETAIN is coming to the United States to participate in the forthcoming celebration at Yorktown, Va., but personally his greatest desire lies in another direction. After the historic pageant has taken place, his intent is not to see the big things of the country; not to glimpse Niagara Falls; not to stand and to admire our skyscrapers; but, rather, to study at close hand the source and the manifestation of "the American spirit".

Marshal PETAIN is outspoken in his praise of what that selfsame spirit wrought at a critical period of the World War. He knows that it then expressed the nation's united purpose to succeed and to face any ordeal or sacrifice necessary to that end. He believes now that we are what we are as an outstanding people largely because of the urge of that spirit, which he considers essentially a national characteristic.

Let us hope that the gallant marshal finds us in this particular all that he expects. Perhaps the broadcasting of his special interest in this field of psychology will serve a useful purpose. May it be the means of routing the pessimistic among us and heartening the while those of us that will not subscribe to the hesitation and even the fear of the doleful. Let all of us show the same high spirit of resolve to see things through that our men did that were sent "Over There". Let us bear in mind the jingle:

"When all the world seems gone to pot,
With business on the bum,
An upturned chin and a smile,
Help some, my lad, help some".

PATENTED POSIES

PATENTS, as many of us know, confer for a specific period proprietary rights upon an inventor. The first purpose of patent protection is to encourage the devising of something new and useful that will be for the common good; and, next, the object is to reward the creative genius by giving him an interval of time in which to reap returns upon his labors.

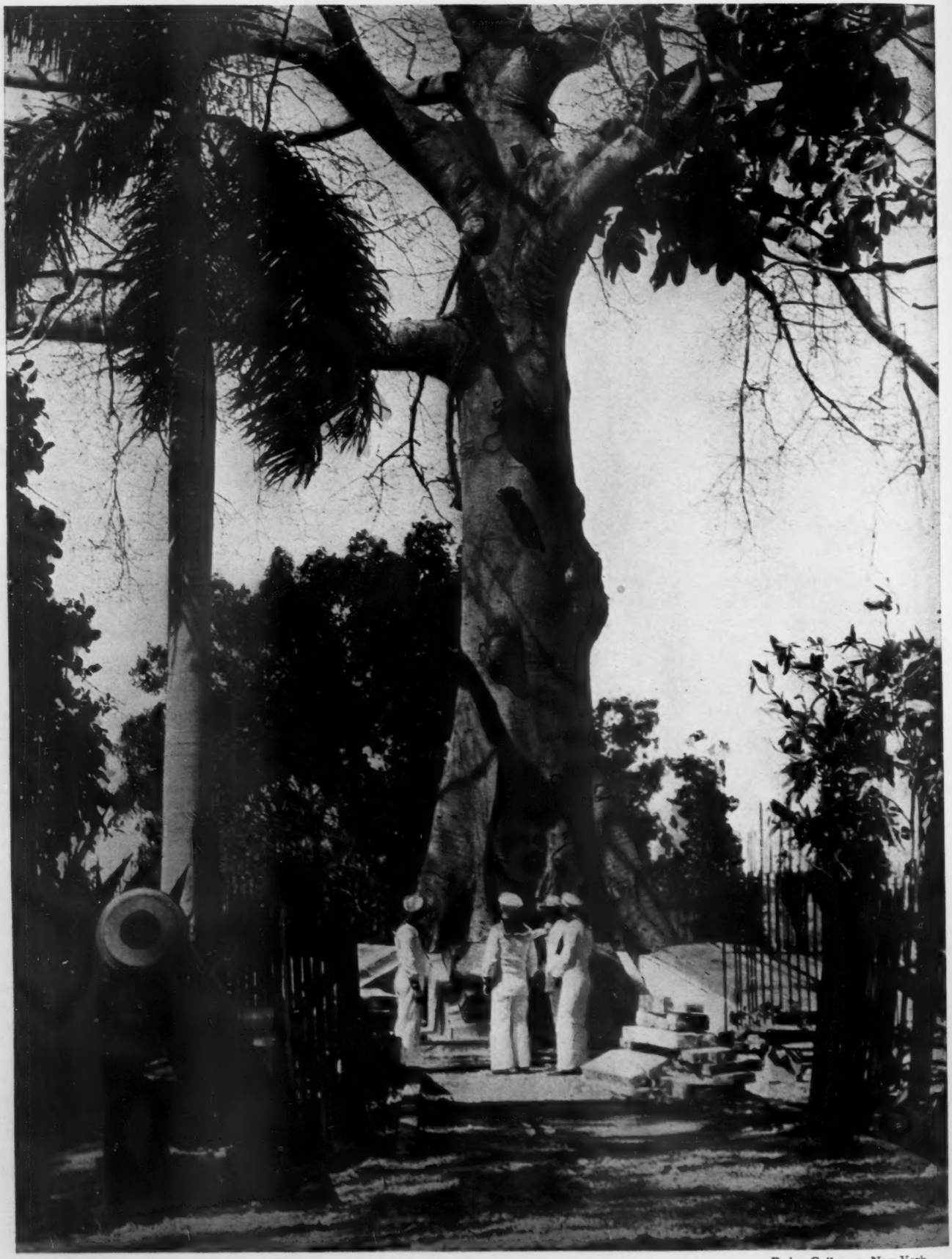
The majority of us instinctively think of things mechanical when we hear the term patent; and it is not yet generally known that Congress a short while back made it possible for plant hybridizers to enjoy similar protection of the fruits of their patient and generally painstaking efforts. This is as it should be, because one has only to read of the amazing things achieved by LUTHER BURBANK to realize that both imagination and intensive work were needed to accomplish what he did. Admitting that his raw material was of God's making, still without his insight and his grasp of potentialities there are scores of fruits, flowers, and vegetables that we would not have today. Men of his kind can now patent these products which are the result of tireless selection and, possibly, crossing.

The first patent of this kind was recently issued on an improved variety of climbing rose; and the same inventor is bent upon evolving another rose which will possess characteristics that are much desired. Before these properties become fixed, considerable time must elapse; and the ultimate patent is, therefore, apt to be well deserved.

PRESENT STATUS OF OUR MERCHANT MARINE

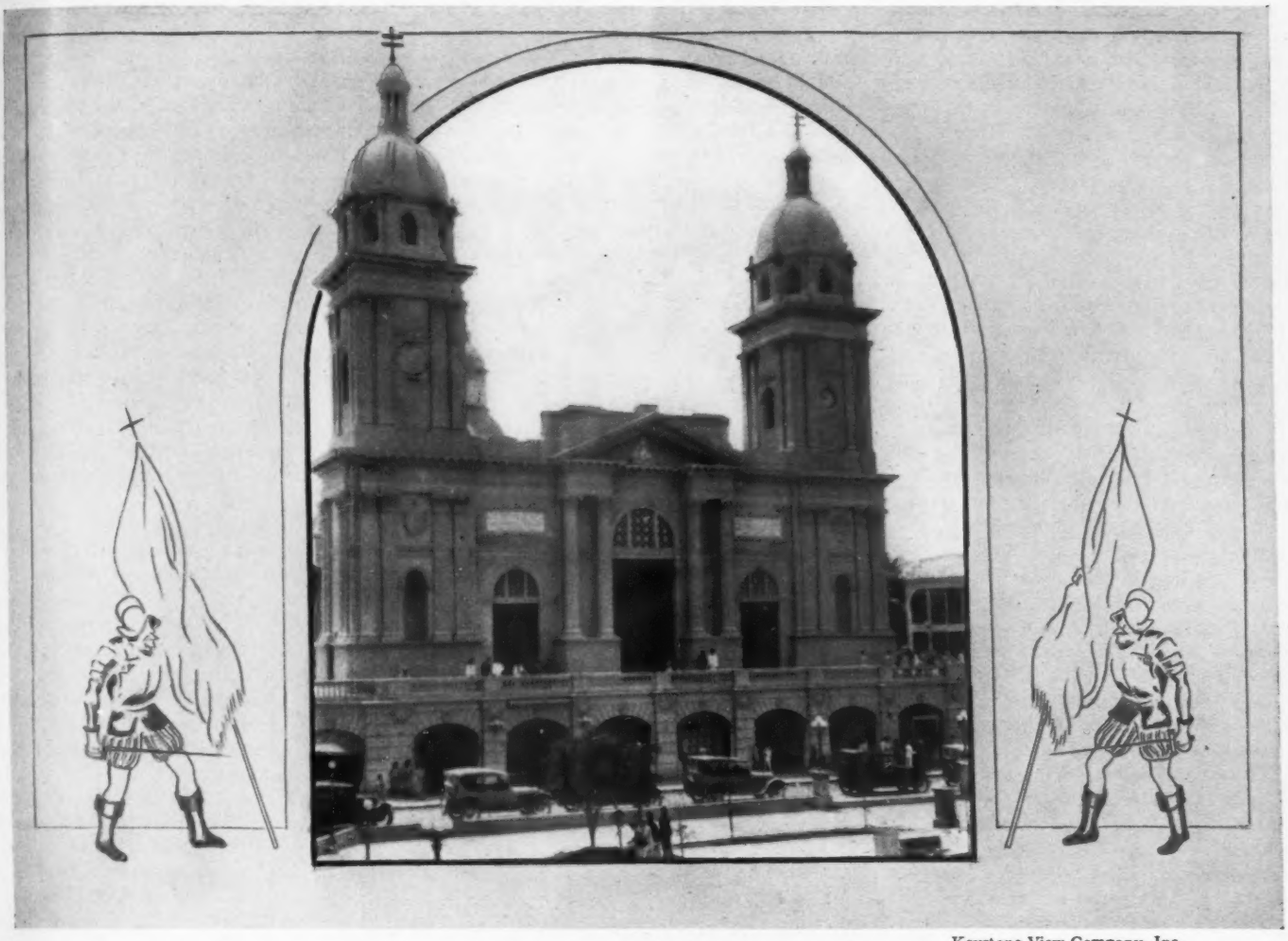
HOW sorry was the situation of the American merchant marine in 1914 was emphasized by the way in which any kind of craft commanded a high price when we were suddenly confronted with the need of more bottoms to carry our sea-borne freight. It is not our purpose here to recount any of the circumstances that led to the substantial development of our merchant fleet. It suffices for the present to know that ships were built by us in large numbers and our flag afloat on the Seven Seas attained a new and much desired position.

The United States Shipping Board has lately made public certain figures that show that the change for the better still continues; and every patriotic American should lend his support to any movement or legislation that will advance the good work. According to the Government authorities, vessels flying the Stars and Stripes transported during 1929 nearly 40 per cent of our total water-borne foreign commerce and more than 57 per cent of the commerce which moved in direct trade—that is, commerce between any two nations conducted in vessels of either of those nations. During the year mentioned the United States carried on commerce with 50 foreign countries; and American craft not only took part in the commerce of all the 46 countries with which direct trade was maintained but were the means employed for all the direct trade with twenty of those countries.



Ewing Galloway, New York

Peace Tree, near Santiago de Cuba, under which General José Toral, acting for Spain, surrendered to Major General W. R. Shafter in 1898.



Keystone View Company, Inc.

Santiago's beautiful and historic cathedral that is a conspicuous feature of the old city.

Santiago de Cuba Engaged on Ambitious Water-Works Project

By E. I. MONTOULIEU, M. E.

SANTIAGO de Cuba is the second largest and the second oldest city in the Pearl of the Antilles. It was founded by Velazquez in 1514, and is, therefore, 417 years old. As might be expected, Santiago de Cuba is full of historic interest, recalling as it does the pioneer days of Old Spain in the Western Hemisphere.

Tradition has it that from the very site of the present City Hall, Hernando Cortes, first mayor of Santiago, set out for the conquest of Mexico after solemnly taking leave of his relative and protector, the Adelantado Diego Velazquez. It was also from the Harbor of Santiago de Cuba that Hernando de Soto sailed with his fleet to the coast of Florida in quest of El Dorado and the Fountain of Youth reputed to be there.

To us of this age and generation, Santiago de Cuba is of especial interest because of the part it played in the Spanish-American War. There it was that Admiral Cervera sought haven with his formidable fleet; there it was that Lieut. Richard P. Hobson tried to bottle up that fleet by sinking the collier *Merrimac* in the channel fairway; and it was from that harbor that Cervera made his courageous dash to the open sea only to be destroyed by the accurate marksmanship of the gunners aboard the blockading American squadrons under Rear-Admiral William T. Sampson. It was against the defenses of Santiago de Cuba that the United States military forces under Maj. Gen. W. R. Shafter fought the decisive battle of that brief conflict and thus virtually brought to a close Cuba's century of strife against the Lion of Castile. The close of the war heralded the birth of *Cuba Libre*.

Santiago de Cuba lies at the innermost part of a bay enveloped by high mountains that long shut her off from the rest of the island save by water. This somewhat isolated position of the city answered well in the days when pirates and buccaneers flourished and the channel to the sea formed the only gateway that lent itself easily to defense. However, this location, that served so well for protection, made extremely difficult the maintenance of a suitable supply of good potable water. No river of any consequence flows into the bay or even into the sea within easy reach, to the east or to the west, of Santiago. The only large streams at all available flow to the east and north of a towering mountain range known as the Sierra Maestra—the southern spurs of which virtually encircle the city.

As far back as 1819, the growth of the city made imperative the providing of a better water supply; and a commission was appointed to study ways and means to that end. After several meetings, the committee resolved that the problem should properly be turned over to the military engineers for solution, and thus washed their hands of any further responsibility. It was not, however, until 1830 that the first water-supply system for Santiago was planned and constructed. At that time a franchise was obtained from

the King of Spain, and Paso de la Virgen Creek was chosen as the source of supply. A small masonry dam was built; an 11-inch main was laid to the city; and a tank—connected with a local distributing system—was constructed at a convenient point. Thus a system capable of providing 350,000 gallons in 24 hours was called into being. Other sources of supply were developed subsequently.

The growth of Santiago has been remarkable since 1898—the population then being about 25,000, whereas it is now fully 145,000. This is an astonishing increase for a tropical city. This expansion—going hand in hand with the adoption of modern standards of living and insistence upon hygienic conditions—compelled a corresponding improvement in the water supply that then amounted to only 1,000,000 gallons daily and forced the authorities to impose very stringent regulations and even to cut off the supply at intervals to safeguard against exhaustion. During the past three decades the government has been obliged, from time to time, to resort to emergency measures to meet the situation; and this state of affairs continued until an extensive public-works program was agreed upon. The present water supply amounts to 3,000,000 gallons a day.

To make water available to the residents of Santiago—no matter what its outlying source, it must be carried across mountains at an altitude to afford the necessary head and yet on such a gradient that the water will flow from the source to the point where it traverses the mountains before descending to the city. The new system traces its way through a notably picturesque part of Cuba, and runs nearly parallel with the recently completed Central Highway which follows the backbone of the island for a distance of 725 miles between Pinar del Rio on the west and Santiago on the east. The system flanks this splendid road for twenty miles; and represents a total outlay of $8,000,000—requiring three years in its construction. According to the plan formulated in 1925, the waters of the Cañas, Cauto, and Mogote rivers, running west of the city, will be used progressively as the demand increases, and dams will be successively reared in these rivers to create reservoirs that will hold, respectively, 10,000,000, 15,000,000, and 20,000,000 gallons.

The system comprises the following principal undertakings: The building of two concrete gravity section dams—one in the Cañas River, to be 101.7 feet high and 1,263 feet long, and the other in the Cauto River with a length of 754.5 feet. The dam for the Mogote River has not yet been designed. The construction of a reinforced-concrete conduit, 54 inches in diameter and 26.7 miles long, with seven siphons each made up of three 3.3-foot-diameter cast-iron pipes, together with bridges, culverts, protective works on steep slopes, several large viaducts, and many associate minor structures. The driving and lining of about 4.5 miles of tunnels, 6.5 feet in diameter, provided with intake and control chambers, sand traps, etc. When the system is completed there will be eight of these tunnels: six not exceeding 656 feet in length; one 2,440 feet long; and one of 17,033 feet. The building of a complete filter and chlorinating plant; two 15,000,000-gallon reinforced-concrete distributing tanks; an aerator; and a hydro-electric station. The latter is to be operated in connection with the aerator and will make use of the 101.7-foot head created by one of the dams.

Work on the project was started in 1928 by Arturo Beltran, a general contractor of Santiago, who sublet different phases of the work to numerous local contractors. All operations and all building materials are under the supervision of government inspectors and are tested according to the standards of the American Society for Testing Materials. Concrete cylinders of all pourings are taken periodically, showing excellent results after tests covering 7 and 28 days, respectively.

The concrete for the piers, abutments, bridges, etc., is of a 1:3:5 mix; for the conduit, 1:2:3; and a mix of 1:2:4, reinforced, is used to line the tunnel sections. The backfill around conduits, piers, and other structures consists of a low-grade concrete, mixed in a proportion of 1:6:12. None of it is left exposed, but is covered with a layer of either 1:3:5 or 1:3:4 concrete, depending upon conditions. The use of concrete for backfill was decided upon owing to the precipitous mountain slopes and to the fear that it might otherwise be washed away by heavy rainfalls. All concrete structures are especially reinforced to resist seismic shocks, which occur fairly frequently in that part of Cuba.

Keystone View Company, Inc.

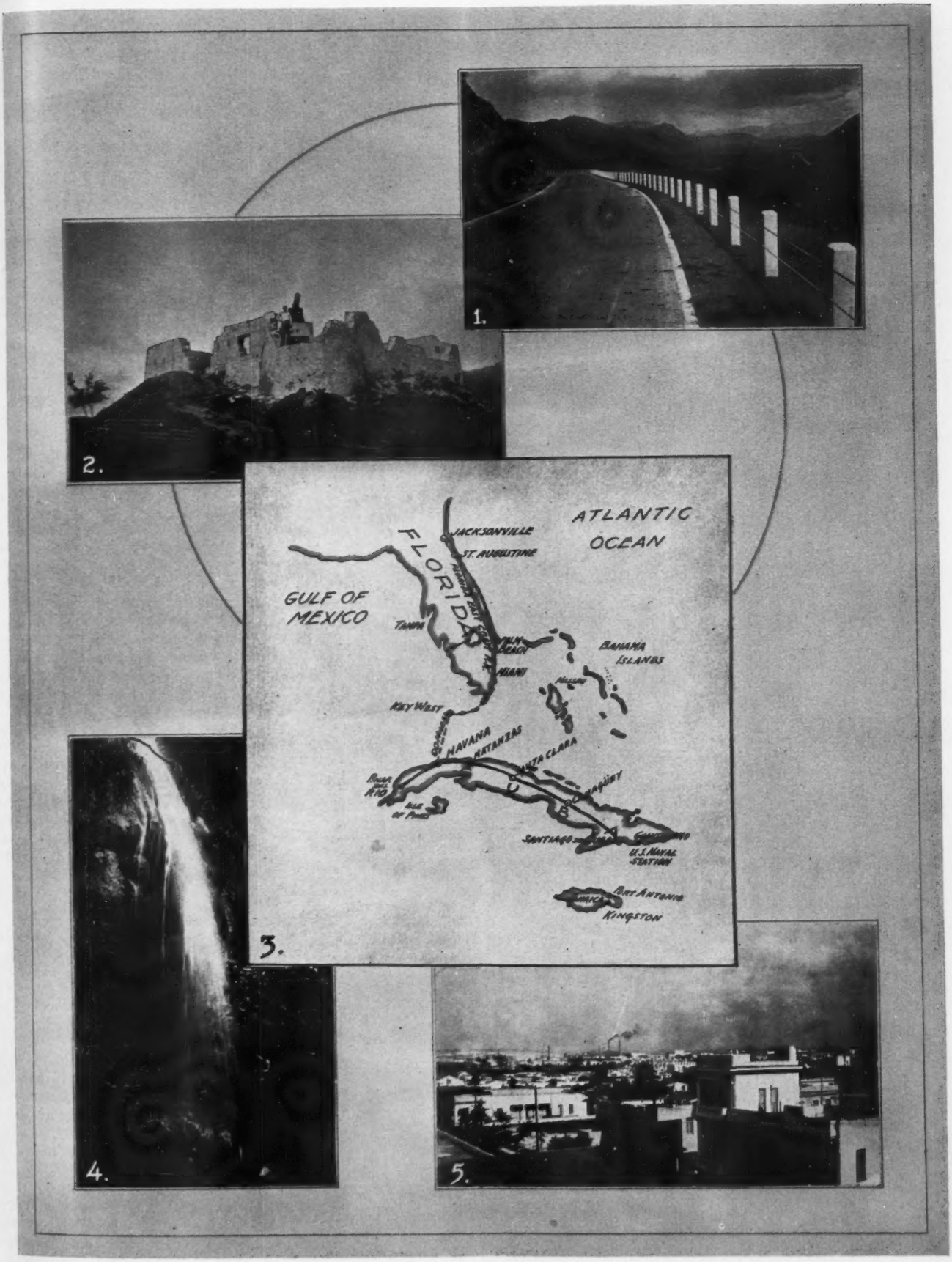
Street in Santiago de Cuba showing typical architecture.

To have a better idea of the project, let us start at Santiago and inspect the aqueduct as we travel west on the Central Highway. The aqueduct lies on an average 500 feet above sea level. Six miles out we come to Loma de las Cuabas, an ancient terrace which plainly tells the story of the island's progressive rise from the sea. There, at a height of about 300 feet, the distributing tanks have been built. This eminence, which gives a fine view of Santiago and the surrounding country, has of late been named Cespedes Outlook in honor of Dr. Carlos M. de Cespedes, the Secretary of Public Works, who conceived and lent his best efforts to the building of the Central Highway and the aqueduct.

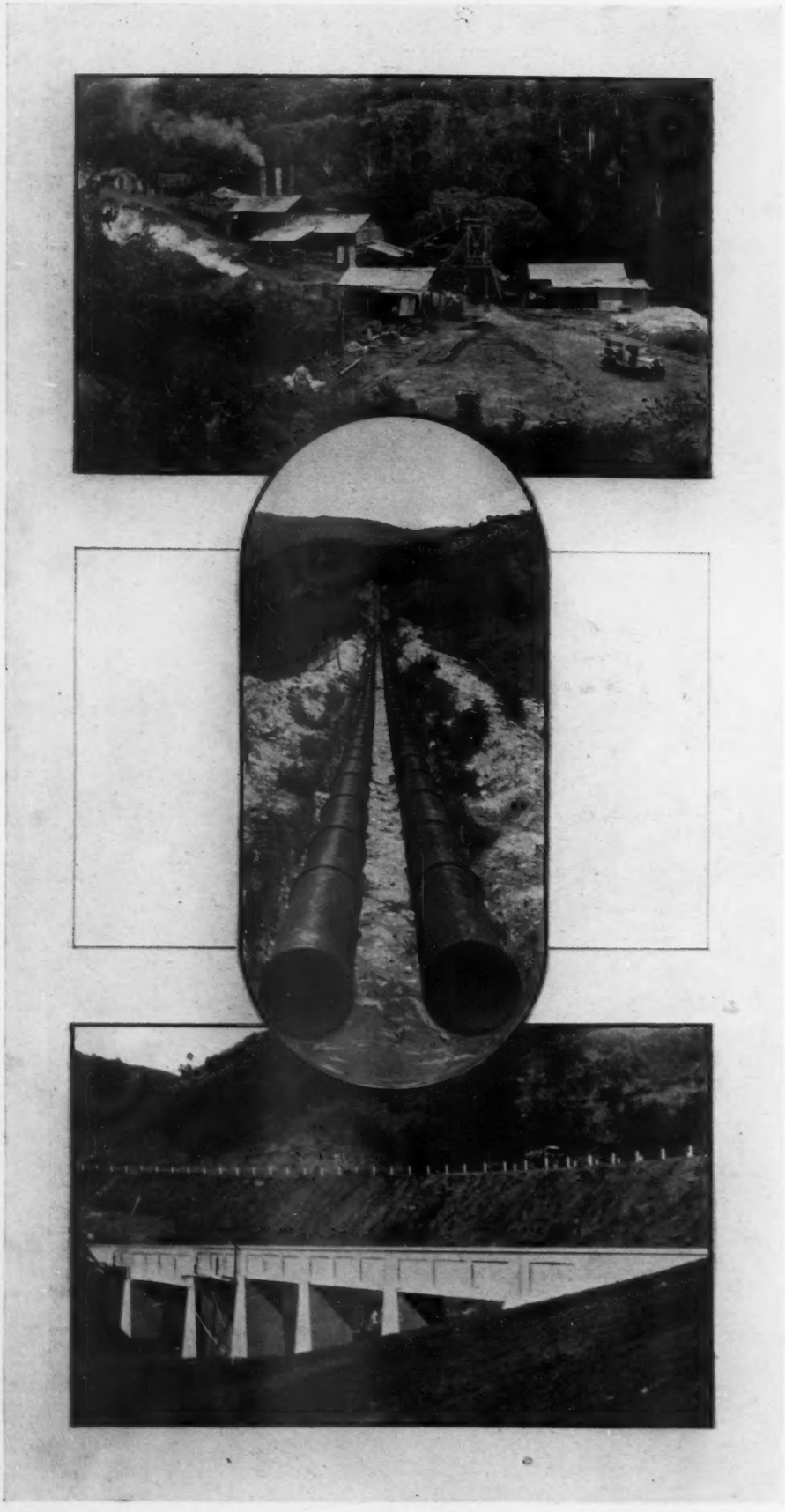
Farther along on the road is Chalons Reservoir, which extends to the foothills of the Sierra Maestra and is Santiago's present source of water. At this point the range is inaccessible except over the military highway locally known as Wood's Folly. It might be recalled here that the late Maj. Gen. Leonard Wood was appointed by President McKinley as military governor of Santiago. One of the first problems that confronted him when he took over that office was to provide work for the people, especially for the soldiers who were readjusting themselves after a period of strife to the peaceful task of reconstructing the impoverished island.

Exchanging war weapons for agricultural implements and substituting civic duties for guerrilla warfare were not easy tasks; but General Wood began the new era by mobilizing a large force of men and paying them at the high rate of $1 a day, a wage unheard of in Cuba up to that time. This force he put to work, under the guidance of the Corps of Engineers of the United States Army, on the road that winds its way up to the crest of the Sierra Maestra at Puerto Boniato. Thus, by combining business foresight with political sagacity, he initiated a policy of public improvements that has not been forgotten, even after a lapse of 32 years, by the Cubans. Not only did he help them to earn a livelihood but he gave them an attraction in Boniato Outlook that is as popular with the residents of Santiago as it is with visitors.

Continuing our tour we reach Siphon No. 4. This connects the aqueduct on the Puerto Pelado Ridge, a few hundred feet to the north of the Central Highway, with the conduit to the south, which will discharge into the filter plant and tanks. At the head of this siphon are provisions for delivering the waters of the aqueduct into the Chalons Reservoir in case of emergency or during periods of heavy spring freshets. Farther along, at the foot of Loma de la Cruz, are the sites for the



1—This picture of the famous Central Highway shows the ruggedness of the country in the neighborhood of Santiago de Cuba. 2—El Viso fortress where the Spanish General Vara del Rey was killed during the Spanish-American War. 3—The Central Highway, linking Pinar del Rio with Santiago de Cuba, will make it easy and well worth while for visitors from the United States and elsewhere to journey from Havana to historic Santiago de Cuba. 4—Picturesque waterfall at Saltadero Creek. 5—Santiago de Cuba as it appears from Cespedes Outlook.



Top—Camp at Shaft No. 1, which is nearly 340 feet deep. Center—One of the cast-iron siphons. Bottom—Where a reinforced-concrete viaduct carries the aqueduct across a ravine near the great Central Highway.

aerator and the hydro-electric plant. The 2,440-foot tunnel, known as Tunnel No. 6, pierces this mountain. At this point the aqueduct turns from the road and, passing north of the Village of El Cobre, is again carried by way of Tunnel No. 8—which is 17,033 feet long—through the main Sierra Maestra.

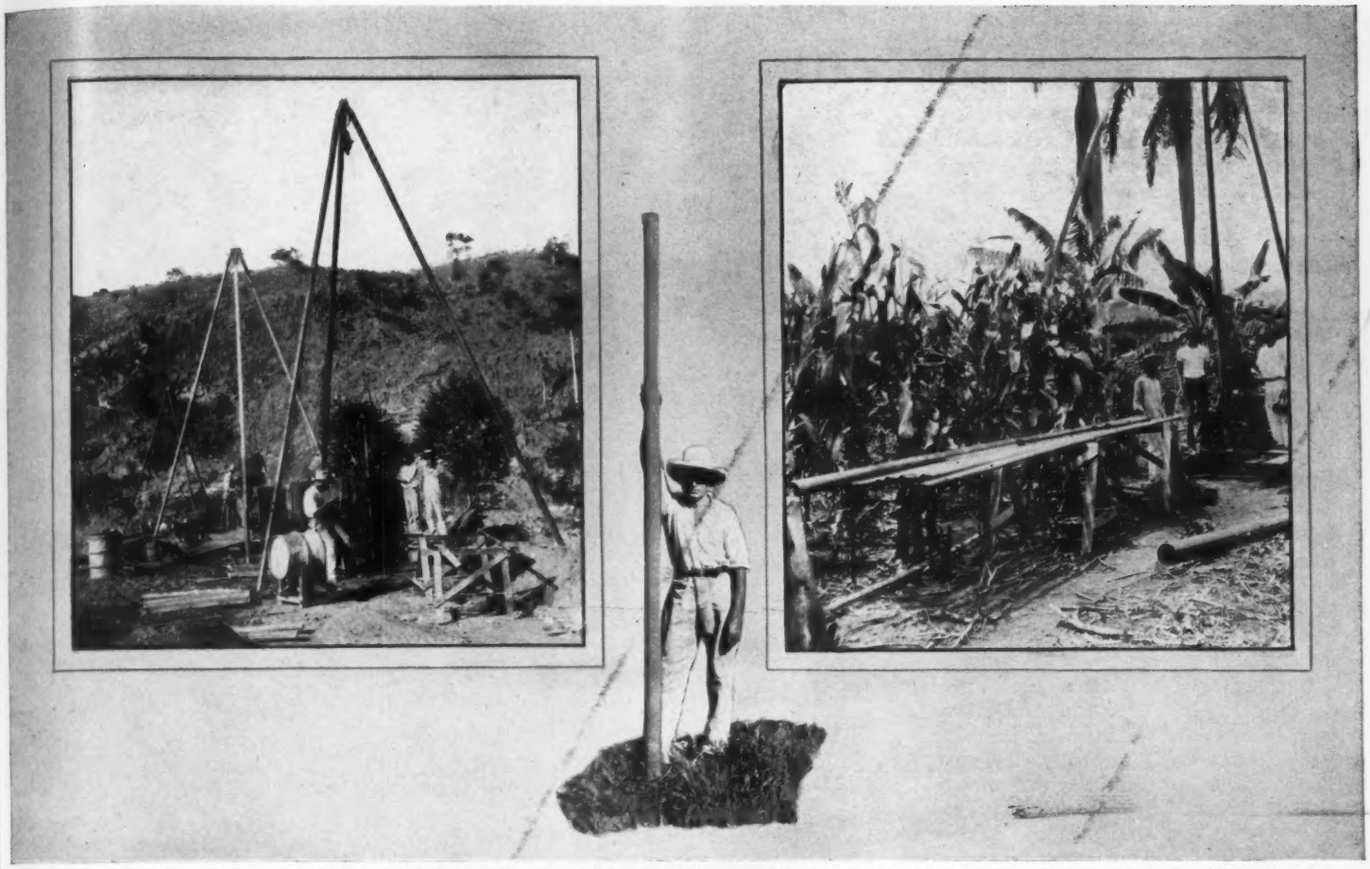
While having no bearing on the subject, mention of the El Cobre copper mines should prove of interest. Though idle of late years, they have been worked intermittently for five centuries, first by the aboriginal Indians—the Caribbeans, and then successively by Spaniards, Frenchmen, Germans, Englishmen, and Americans. They are said to have yielded millions of dollars worth of copper, gold, and silver. According to an eminent American mining engineer, copper utensils found in the possession of Indian tribes in Florida and other southern states unquestionably had their origin in Cuba, as analysis has proved them to contain the same gold and silver values as the ores from El Cobre. Proof also, so he claims, that the Carribbean Indians were proficient in the metallurgy of copper.

Another feature that characterizes the El Cobre mines is their wetness. The enormous volume of drainage water in the extensive and deep workings gave rise in 1916 to what has since become a classic in dewatering jobs by the air-lift method. The necessary equipment was furnished by the Ingersoll-Rand Company, and the work was done under the able guidance of Edward H. Emerson, then chief engineer of the mines.

Leaving behind the ancient mining center we travel toward the Cañas River, one of the three streams to be dammed, and arrive at Charco Mono Gorge, a little more than a mile south of the west portal of Tunnel No. 8. This is the Cañas River dam site. To assure a firm foundation for this structure it will be necessary to remove an overburden of sand, gravel, float, and weathered rock covering the channel and sections of the banks to a depth of approximately 23 feet. The country rock is a volcanic breccia of medium grade intruded in places and underlaid by dikes of a fine-grain porphyritic diorite.

Extensive core-drilling was carried on to determine the profile of the sound rock and the nature of the underlying formations. Several sites were investigated by means of surface and deep drills, and more than 3,000 feet of holes, with a core recovery of 70 per cent, were put down during this work. Calyx drills were used for this purpose; and they gave the utmost satisfaction. With these drills no difficulty was experienced in penetrating all kinds of rock, including deep overburdens of alluvial material, sand, gravel, boulder beds, some very hard diorite, volcanic breccia of all grades and textures, as well as fine and coarse and soft and indurated volcanic tuff.

The equipment consisted of one F-32 and two M-3 drills, which were operated 24 hours a day in three 8-hour shifts for two years. The average advance was 26.25 feet a day. While many of the holes had a diameter of 2 inches, it was decided to standardize on a 4-inch hole because it was found to give a better core recovery. Cores 4 and 5 feet long



Left and right—Set-ups for Calyx drills at points along the line of the aqueduct where borings were made to determine the nature of the rock through which tunnels were to be driven. Center—Rock core section cut by one of the Calyx drills.

were pulled regularly. In one case, when going through a tuffaceous breccia of a fairly even grain, 3-inch cores 10 and 12 feet long were obtained frequently.

When completed, the Cañas River dam will create a reservoir with a capacity of 5,000,000,000 gallons yielding normally about 10,000,000 gallons daily. The water will be impounded for a distance of 8.7 miles upstream—the total area of the watershed aggregating 27.8 square miles. An intake tower and conduit will carry the water into Tunnel No. 8. This is circular in cross section except for the bottom, which is flattened 2.6 feet below the springing line.

Tunnel No. 8 was driven east and west from two portals and from four shafts, the latter varying from 69 to 338 feet in depth. To determine the nature of the formations to be penetrated, holes from 8 to 12 inches in diameter were drilled about every 328 feet along the axis of the tunnel. Churn drills were used for this purpose, and no casing was required for any of the holes. These exploratory borings revealed solid and sound formations with differing amounts of ground water, which at no time was sufficient in volume to endanger the workers. The large-diameter holes served to facilitate ventilation, and they were also in the nature of a precautionary measure—means of access to the tunnelers in case of cave-ins or other accidents.

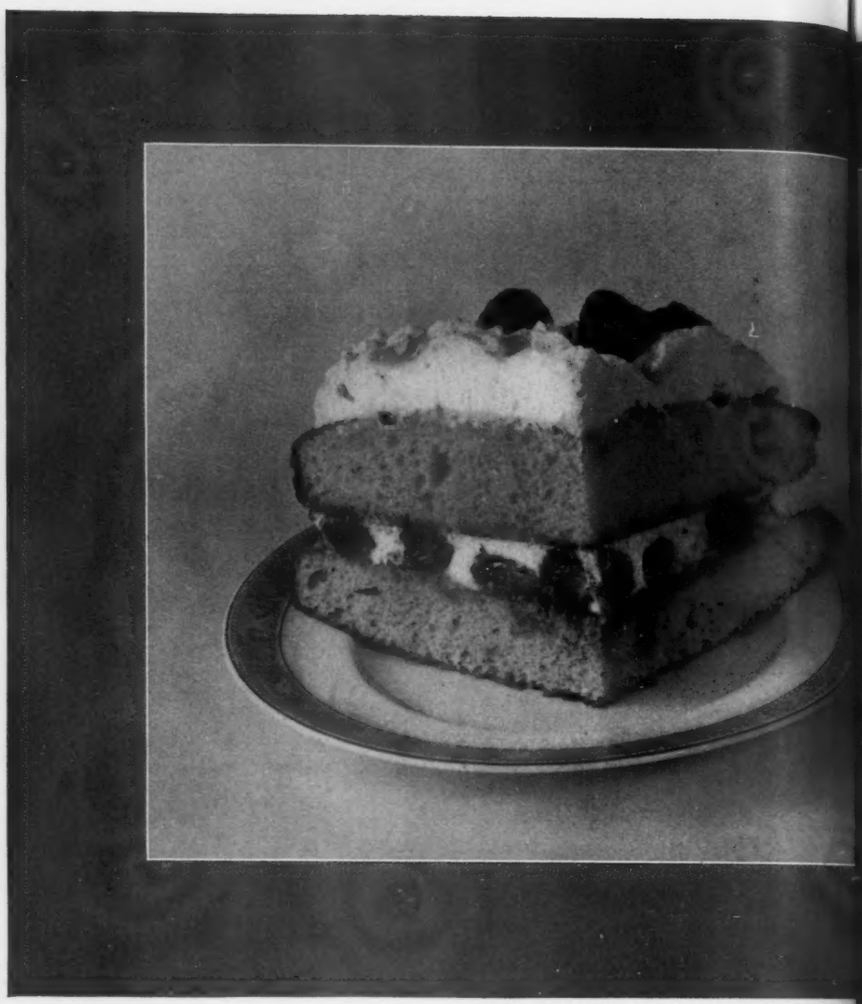
Natural ventilation was relied on in the main; but where blowers or exhaust fans had to be installed the exploratory holes proved very helpful in making the men more comfortable. The tunnel temperature averaged 75° F. The fans were driven by CM and DM air motors, as were also the small centrifugal pumps used to dewater the tunnel at the headings. These motors gave excellent service—one of them operating continuously on a pump for 75 days. Not one replacement part was required for any of the four air motors on the job.

The main plant—including compressors, drill-sharpening machinery, drills, hammers, air hoists, and Cameron pumps—was located at Shaft No. 1, which was situated approximately midway between the tunnel portals. The work of shaft-sinking and tunnel-driving was done in the main with S-49 "Jackhamers" and N-75 drifters; and all told 65,397 cubic yards of rock was handled in excavating Tunnel No. 8. Except for distances of less than 1,000 feet, when it was man-hauled, the muck was removed by mules and burros. Owing to the smallness of the tunnel section, no mechanical mucking was attempted. A complex system of faults, fissures, and joints traversing the country rock caused the overbreak to be heavier than was expected. But, despite that fact, and the rather large charges used, the overbreak, amounting to approximately 40 per cent of the tunnel area, was regarded as fair.

Some sections of the tunnel, especially at the portals and in the vicinity of the shafts, are being reinforced at the time of lining, which is in progress. The lining has a minimum thickness of 8 inches. Prior to the arrival of forms and pneumatic concrete-placing equipment the lining was done by hand. Collapsible forms are utilized, and these are made up in three sets, each 42 feet long, so that a section can be poured, set, and moved forward every eight hours. Mixing plants have been installed at the portals and the shafts; and in the case of the latter the concrete is dropped down wrought-iron pipes into strong, concrete-bottomed bins so arranged that cars can be run under them for loading.

Owing to the world-wide financial condition, the government is forced to curtail expenditures upon the water-works system, and only units absolutely essential will be pushed to conclusion at present. The project as planned will not only add greatly to the hygienic status of Santiago but will make that historical city a more desirable place for beauty-seeking tourists.

The story of the making of silverware is told in an interesting manner in a new moving picture lately completed by the United States Bureau of Mines in coöperation with a large manufacturing concern. The picture is entitled *Silver, Heirlooms of Tomorrow;* and copies of it may be obtained for purposes of exhibition by schools, clubs, churches, civic and business organizations, and the like. Application should be made to the Pittsburgh Experiment Station, United States Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa. No charge is made for the use of the film; but the exhibitor is expected to pay the cost of transportation.



The real thing in strawberry shortcake

Frozen Pack a Boon to Ber

FRESH fruit in abundance in and out of season is one of America's gastronomic blessings. We owe this dietary wealth mainly to two contributive agencies: First, to a highly developed system of rapid distribution through up-to-date means of transportation; and, second, to the preservative action of refrigeration skillfully and extensively employed.

Not only have the foregoing agencies added greatly to our physical well-being but they have enabled the producers of these foodstuffs to find ready and profitable markets for their commodities—thus altering radically and for the better the economic conditions under which they operate. Among the millions of us who are in finer shape physically because of the part played by fruit in our diet there are comparatively few aware of the revolution that has been brought to pass through the present systems of handling perishable foodstuffs. The advance has been a continuous one, with occasional longer strides forward of outstanding significance. Our present interest is in one of these momentous advances that is fraught with varied potentialities.

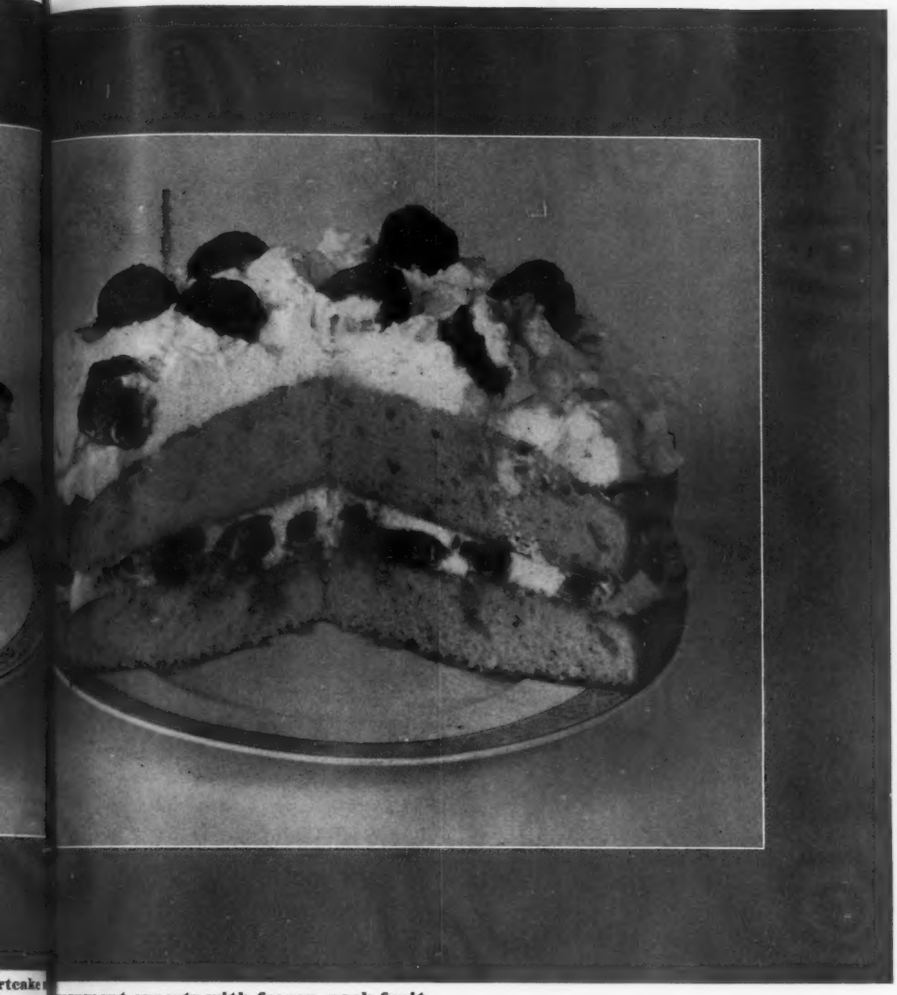
For some years, experts of the United States Department of Agriculture have been engaged in a series of researches having to do with the adaptation of the frozen-pack method to the preserving of berries grown in the Pacific Northwest. Anyone that has lived there or visited that section of the country at the height of the berry season knows to his delight how luscious the berries are that flourish there. Climatic conditions have made the western parts of Oregon and Washington notably suited for the production of large yields of berries possessing the finest qualities. Nature has done her best to help the growers, but geographical circumstances have hampered the marketing of the berries during the periods of flush production. Certain of the fruits are only acceptable to the ultimate consumer when thoroughly ripe; and berries in that state are not readily transportable long distances because they are apt to spoil in transit. The problem has been to find ways of handling the small fruit so that deterioration could be prevented and the products put up in a manner that would virtually preserve their freshness for months.

Efforts to this end had their start about two decades ago in Salem, Ore., and consisted primarily in the utilization of what is variously known as the cold-pack or the frozen-pack method. The procedure followed is that of putting the fruit in barrels or other acceptable containers, with or without sugar, and then in freezing and storing the pack at relatively low temperatures. The sugar and the low temperatures serve to arrest chemical changes and cause the fruits to retain substantially all their characteristic fresh flavors. At the start, the quantity of fruit so treated did not exceed annually more than a few hundred barrels, but the demand gradually increased and the industry expanded until the pack in 1928 totaled in the neighborhood of 100,000 barrels—each barrel having a capacity of 50 gallons.

While containers of lesser capacities were adopted in the course of time—being mainly 5, 10, and 30 gallons in capacity—still the principal outlet for the frozen-fruit pack remained through channels that have preferred the largest of the containers. Manifestly, quantities of this magnitude appeal to the wholesaler or to certain large consumers—among the latter being manufacturers of preserves and kindred commodities. While the availability of these users has been of great benefit to the growers, still that disposition of the surplus fruit has only partly solved the problem of profitably and effectually disposing of the entire crop. Therefore, following the present merchandising trend, efforts of the Government experts have recently been centered in devising ways and means by which frozen packs of fresh fruit could be produced in sizes that would appeal to the retail trade. The retail trade, by the way, is typified in the last analysis by the decidedly exacting housewife. A package of frozen fruit to be acceptable to her must be attractive to the eye when removed from the refrigerator and it must satisfy the palate when eaten. The layman little realizes the difficulties that have beset the path of the investigators. Even so, much has been accomplished; and while more research is needful to establish a sound foundation for this department of industry, nevertheless noteworthy progress has been achieved.

The fruits so far put up by the frozen-pack method are strawberries, blackberries, raspberries, gooseberries, currants, and cherries. Up to date, strawberries represent the largest volume of the output; and next in volume come red raspberries. Several varieties of some of the aforementioned fruits are so packed; and among the blackberries is the Loganberry, the delicious cross between the blackberry and the raspberry. Before describing the actual steps developed by the technicists of the United States Department of Agriculture, we should explain one of the basic differences between preserving by heat and preserving by cold.

Heat-preserved berries need not be thoroughly ripe before undergoing treatment. This is due to the fact that the application



vernment experts with frozen-pack fruit.

rowers in Pacific Northwest

By ROBERT S. GREGG

of heat brings about certain transformations in the fruit that cloak the original immaturity of the raw commodity. We all know how green fruits make delicious preserves, jams, and jellies—heat and sugar jointly bringing about the toothsome transformation. The cold-pack process, on the other hand, necessitates the use of ripe fruit—just the kind of fruit that one would expect, for example, when asking for a plate of fresh strawberries. The fruit must have no green tips or other signs of immaturity, because the cold pack will not change these and make the fruit attractive to the eye as well as palatable. In other words, the fruit must reach the packer when in its best condition for eating—that is, luscious, ripe, and full flavored. This means that the grower must gather his fruit, assort it, and deliver it to the packer with all practicable dispatch; and the packer must put it up in the course of a few hours in order to avoid spoilage. The element of time plays a prime part in the treatment of the fruit from start to finish. Time saved then insures the subsequent keeping qualities of the commodities.

The fruit is generally washed after sorting and before packing, and is then drained so that as little water as possible is carried into the barrel with the fruit. Most strawberries are packed with cane sugar; and considerable quantities of red raspberries are so handled, although there is a tendency to pack raspberries without sugar. Logan and other blackberries are packed very largely without sugar, so we are informed by a technical bulletin issued by the Department of Agriculture. Most of the fruit preserved by the frozen-pack method is put up without any preservative other than cane sugar.

As soon as a barrel is filled and sealed it is moved to a cold-storage room; and the interval between filling and freezing is made as brief as it is practicable to do so. The temperature maintained in the average cold storage for freezing berries in barrels is from 10° to 15° F., but in many plants the temperature is kept as low as zero. After a considerable portion of the berries in a barrel have been frozen, the fruit can be shipped long distances either in refrigerator cars or in the refrigerated holds of vessels. Upon arrival at their respective destinations, the barrels must either be carried promptly to cold storage for subsequent issue or opened and their contents disposed of in a short while.

As a result of Government investigations carried on during 1924, 1925, and 1926, much data was obtained of value to packers engaged in putting up fruit in various sizes of barrels by the frozen-pack method. Certain details were developed bearing upon the amounts of sugar to be used to advantage; the ranges of temperature to be employed to avoid fermentation and spoilage; and the limiting intervals that should elapse between the picking of the fruit and the completion of the initial freezing. It was found that fruit packed without sugar or with low cane-sugar concentrations should be moved to storage promptly and cooled as quickly as possible to avoid fermentation. The chemical characteristics of berries, which are important in the manufacture of jams and jellies, are not significantly affected by storage of the fruit in the frozen state. The texture of strawberries, for preserving purposes at least, may be considerably improved by frozen storage; but strawberries frozen without sugar showed a decided loss in flavor and color as compared with the fresh fruit at the time of packing. So much for the work and accomplishments leading up to the researches conducted in the Pacific Northwest during 1929. The latter investigations dealt exclusively with the procedures to be followed in preserving fruits and vegetables in small containers by means of the cold-pack process.

The work cut out for the experts two years ago was to ascertain the behavior of certain fruits and vegetables when packed at the point of origin with different sweetening agents and when put up at various freezing temperatures in containers of paper, tin, or glass. Also, the experiments had to do with the value of vacuum sealing at different degrees of vacuum. There were other technical points which were made matters of consideration, but we need not enter into these in order to emphasize the significance of those foodstuff studies.

The mere idea of preserving the commodities was not the controlling one. The aim was to develop packages of readily marketable sizes and of an appearance that would meet with the approval of the ultimate purchaser. It was essential that the packages should be acceptable when bought and satisfactory in all respects after removal from the domestic refrigerator. The American housewife is a very discriminating person. To win her favor many things must be considered in putting up a package foodstuff; and the producer can be sure that she will not make a second purchase if the product is not all that she is led to expect it to be.

We are all fairly familiar with the widespread use of freezing in the preservation of meats and fish, and, offhand, one might expect animal tissues and vegetable tissues to act alike at low temperatures. The experts of the Department of Agriculture have proved that this is not the fact, and they have established that fruits must be frozen at a dif-

Workers in the Oregon Agricultural Experiment Station preparing strawberries for freezing.

ferent rate lest their cell walls and tissues be damaged and their flavor and texture impaired or altered accordingly. It is injury of this sort that is apt to lead to the dissatisfaction of the consumer.

The following summary of the results obtained by the Government experts appeared in an article by V. B. Bonney, associate chemist of the Food and Drug Administration, published in *The Glass Packer*.

"That fruits frozen with sugar or syrup result in a higher quality product.

That heavy sugar syrup is apparently the best packing medium for frozen fruits in small containers.

That a vacuum pack has a decided advantage over packing in air—melons being a lone exception.

That glass jars and inside-enameled tin cans appear to be the most suitable containers, except in the case of non-vacuum pack where paraffin-paper cups serve as well.

That any temperature less than 21° F. is satisfactory if the product is placed in the refrigerating room so that it is rapidly cooled.

That clean fruit packed and frozen in a heavy sugar syrup in sealed packages can be kept at room temperature for several days after removal from cold storage".

Most of us know that exposure to oxygen, combined with a temperature high enough to induce molds and fermentation, is the cause of deterioration in foodstuffs. Vacuum, therefore, minimizes the amount of oxygen present during the time the container is sealed; and the submergence or coating of the fruit in syrup also tends to shield the berries from the action of oxygen for some while after a package is opened.

It is not unlikely that some means of insulating packages will be devised for the purpose of prolonging protection, and this will add materially to the period that a package can safely be held outside of a refrigerator without inviting impairment of its contents. The industry undoubtedly will find ways to facilitate the repackaging of frozen-pack fruit and vegetables at points of final marketing; and success in this field of the business will, of course, hinge largely upon skillful handling and speed in distributing the commodities to the retail trade. Just how the use of small packages in the cold-packing of fruits has increased is made plain by the statistics of the industry in the Northwest during 1929. In that year more than 1,200,000 paper cartons, containing one pound each, were marketed.

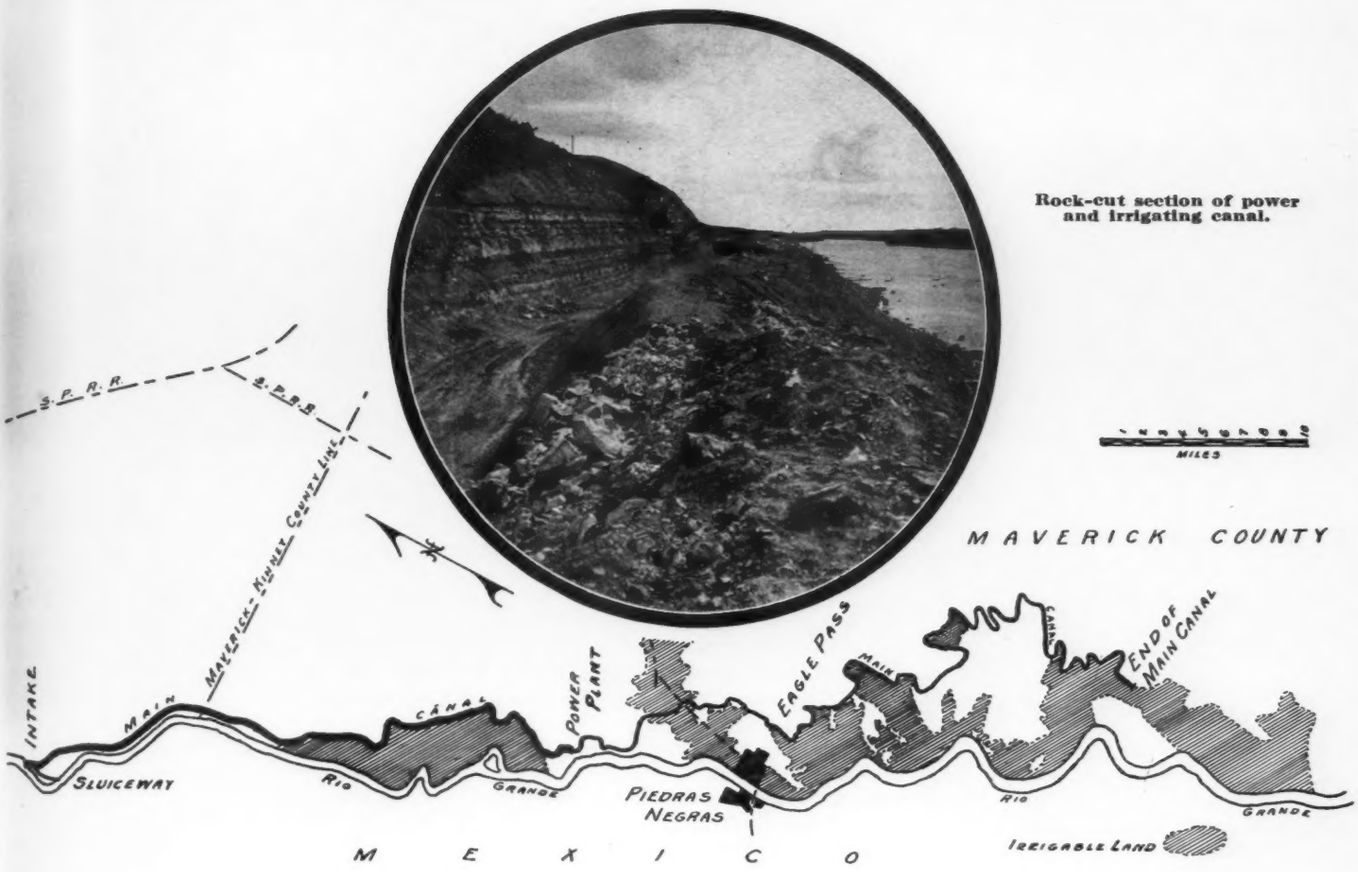
This work, in which the Department of Agriculture has played a conspicuous part, discloses an extremely interesting aspect of the preparation, the distribution, and the profitable marketing of some highly perishable foodstuffs that are not only pleasing to the palate but of benefit to our bodies. Seasonal surpluses that otherwise might go to waste can be made to yield compensating returns to the grower and to the packer. Once more we have evidence of the ever-widening field of usefulness of refrigeration.

Jars of frozen strawberries and cherries packed by experts of the United States Department of Agriculture.

BURNING GLASS SOURCE OF HEAT FOR METALLURGICAL FURNACE

IN THE Artillery Museum of Stockholm there is on exhibition an ancient mirror of large dimensions that was used by the Swedish army in days long gone as a means of defense against approaching hostile ships. The mirror, the story goes, was placed so as to catch the full force of the sun's rays and to reflect them on the vessels in order to set them afire.

On the principle of the burning glass two Swedish physicists have constructed a melting furnace for scientific purposes. Instead of the sun, an electric arc lamp is the source of heat, and the mirror on which the light is focused is elliptical in form. During a recent demonstration of the furnace before the Society of Physical Research, according to *The Engineer*, the inventors obtained a temperature high enough to fuse a metal having a melting point of about 3,812° F., while a piece of platinum was made to boil like a liquid in four minutes.



Rock-cut section of power and irrigating canal.

Rio Grande Being Made to Irrigate Larger Area in Maverick County

This Interesting Undertaking in Texas Is the Outcome of Four Decades of Agitation

By R. G. SKERRETT

FOUR hundred years ago, when the Spaniards first threaded the Rio Grande Valley, they called the river the Rio Grande del Norte. That grandiose title was conferred by the pioneers probably because they saw the stream at flood periods when it flowed magnificently and even tumultuously seaward.

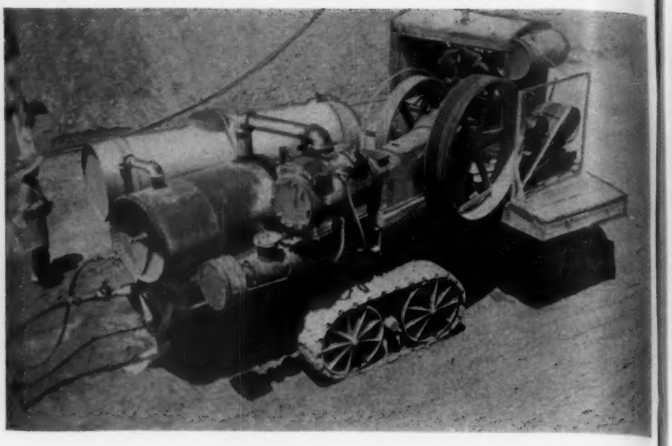
The Rio Grande, however, is a river of extremes. During the dry months it dwindles to unimpressive proportions, and then for long distances in its course through the coastal plain it bares most of its bed. Largely because of this wide variation in the volume of its water, the river has delayed for decades the development of the contiguous section of Texas; and only within recent years have steps been taken by the people of the United States to conserve a measure of the flood-period abundance so that life-giving water would be available at all seasons to vitalize vast acreages of otherwise arid land.

When Coronado followed the course of the Rio Grande, he found the Indians then living there making use of water from the stream to irrigate their farms. They did this by means of diversion ditches; and in that practice they merely imitated other aborigines who are believed to have occupied the country hundreds of years previously. Much of the soil so benefited needed only the magic contact of water to make it bear richly in a section where the sun shines from unclouded skies for the greater part of every twelvemonth. So much for the distant past.

Our present interest in the valley is centered in Maverick County, which lies in what is known as the "winter garden district" of the southern section of Texas. Maverick County is a triangular tract that has its long side flanking the river for a distance of about 80 miles. Its east-and-west side is 33 miles long; and its north-and-south side is 65 miles long. As counties go in Texas, Maverick County is not big, but it has agricultural possibilities of a high order. Eagle Pass, a small border town of 7,000 inhabitants, is the only sizable community in the county; and on the opposite shore of the river is located the Mexican city of Piedras Negras, which boasts a population of 20,000. San Antonio, which lies about 160 miles north and east of Eagle Pass, can be reached over a well-paved asphalt highway; and a branch line of the Southern Pacific runs to Eagle Pass. Therefore, Eagle Pass is within reach of the whole country through thoroughly modern means of transportation.

Fort Duncan, established in 1846, was the nucleus of the first American settlement in the territory. There it was that Gen. Robert E. Lee was stationed immediately after he was graduated from West Point. The first private building was, as one might expect in an arid country, a saloon. Maverick County in its earlier days was mainly a cattle-raising section of the state. After the Civil War, quick-shooting gentry of questionable character made Eagle Pass their headquarters; and the place made little social headway until the railroad penetrated there in 1882 and brought in its wake a measure of civil stability. Thereafter cattle-rustling became less common, and a period of real progress started.

Rainfall in Maverick County averages but little more than 20 inches in the course of a year; and that rain is poorly distributed and occurs irregularly. Furthermore, evaporation is very high because of the intensity of the sunlight. Accordingly, no dependence could be placed upon rainfall for the raising of crops; but in other ways climate and soil favor agricultural activities the year round. The logical desire for fresh vegetables and other



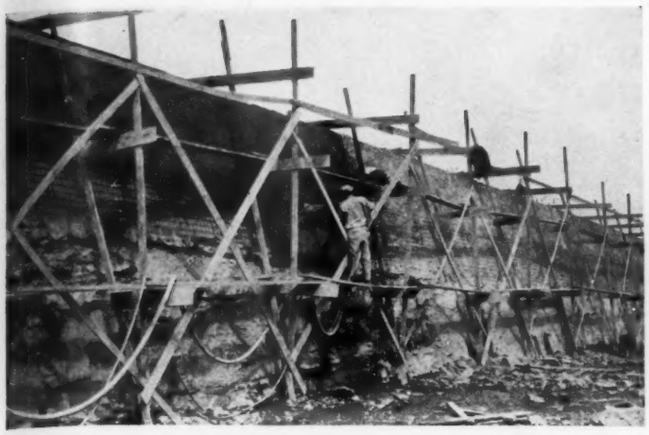
farm products successively spurred the more progressive of the citizenry to advocate recourse to irrigation—the water to be drawn from the nearby Rio Grande. The benefits of such a course were made clear by the established practice of farmers living across the river in the neighboring Mexican State of Coahuila who diverted water from the Rio Grande and thus made fruitful their expansive acres.

While the people of Maverick County talked for 40 years or so about constructing an irrigating ditch, still nothing was achieved along the line pursued so successfully in Coahuila. The nearest approach was the establishment, above and below Eagle Pass, of irrigating systems that obtained their water from the river by steam-driven pumps discharging into networks of irrigating canals. The primary source of power was lignite mined in the county. Later on the steam plants were converted into electric plants; and these pumping stations now supply water to approximately 3,000 acres—only a very small percentage of the lands in the region that can be made profitably productive by irrigation. However, the harvests reaped from the acreage so benefited have shown convincingly the economic advantages that are realizable.

It is not our purpose to detail the efforts made in the past to organize actual steps looking towards the drawing of water from the Rio Grande for use on lands in Maverick County. A number of surveys were made, and numerous experts were consulted, but various circumstances arrested actual accomplishment. After a survey, F. W. Maltby, a Government engineer, reported in 1895 to P. W. Thomson, a Maverick pioneer, that water could be diverted from the river and delivered by gravity to some 20,000 acres in what is known as the Quemado Valley. Mr. Maltby, therefore, deserves credit for his pioneer work in pointing out the way to the desired goal, although his plan was not executed.

The undertaking now in hand, which will supply 66,669 acres with water, was developed by W. L. Rockwell, a noted irrigation engineer, and is the result of steps initiated in 1925. On June 9, 1926, the Maverick County Water Improvement District was formed; and the District was authorized by a permit issued on November 9, 1927, by the State Board of Water Engineers to divert 600 second-feet of water from the Rio Grande for irrigation purposes. A bond issue totaling $4,800,000 was voted on December 19, 1927, in support of the work. Up to this point the aim was to provide water for irrigation only, but then was proposed a plan also to generate power. As a result, the first 32 miles of the canal was redesigned; an additional permit for power diversion was obtained from the state authorities; and a supplemental bond issue for $1,800,000 was voted. Finally, a contract was made with the Central Power

Means and manner of placing concrete with compressed air in



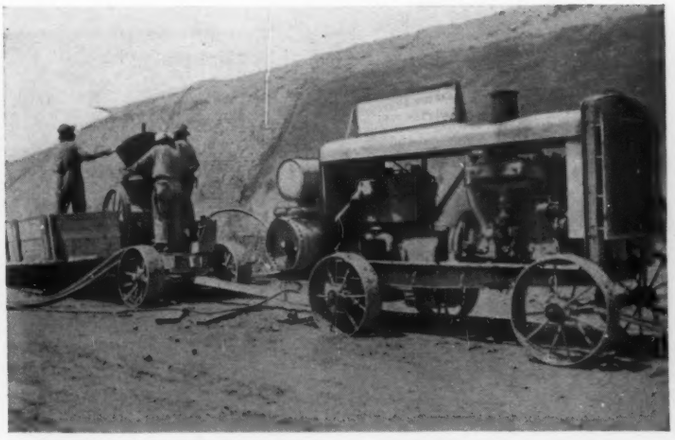
& Light Company for the sale of the power flow. After permission to go ahead had been secured from the Federal Power Commission, the way was cleared for the construction of the waterway that will undoubtedly prove a boon to the county.

On August 21, 1929, the District was reorganized as the Maverick County Water Control and Improvement District Number One; and on December 11 an agreement was signed with Ulen & Company, the general contractors for the work. As now planned, the project will involve an outlay of $6,600,000, and it will provide for the irrigating of 66,000 acres of so-called gravity land and 25,000 acres which can be served by low-lift pumping. As finally located, the District boundary line encompasses 156,426 acres; and less than half of this area can be irrigated by gravity. While the soils, mainly because of a lack of water, at present produce only cactus, mesquite, white brush, and grasses, nevertheless by cultivation they may be made to yield large crops of vegetables, fruits, nuts, cotton, corn, alfalfa, etc. The irrigable areas are of a rolling topography that will insure proper drainage and prevent bogging and ponding. Records covering a period of 32 years disclose that the average frostless season totaled 270 days; and the sun was found to shine anywhere from 43 to 72 per cent of the time.

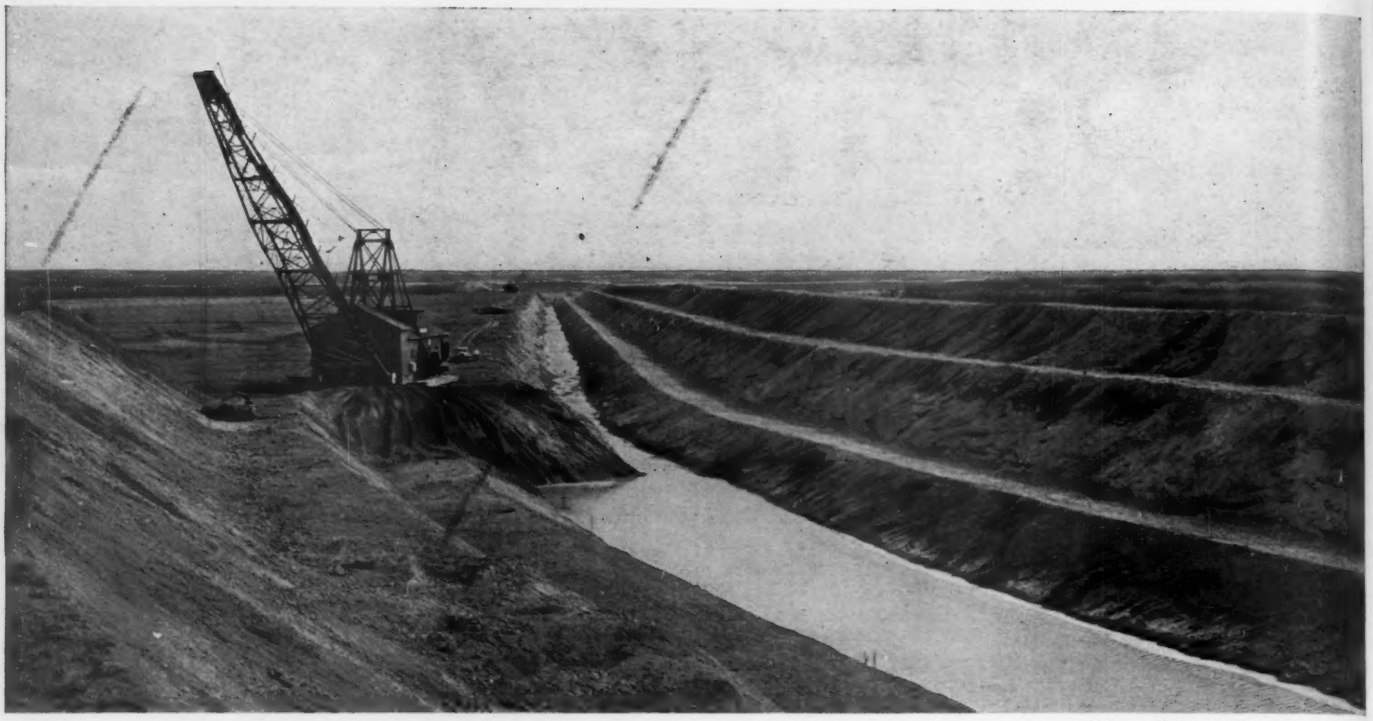
Broadly stated, the canal will have a total length of approximately 90 miles. The first 32 miles will serve the double purpose of furnishing water for irrigation and for the development of power, and the remainder of the canal will carry water only to irrigate neighboring lands. In the section that is to render two services there will be a flow of 1,500 second-feet of water, while the flow in the longer and smaller section of the canal will be at the rate of 500 second-feet. Between the intake end of the main canal and the point where the power house will be located, the canal, while having a suitable gradient to provide flow, will yet be 83 feet above the river at the power plant. This will insure a sufficient head and an ample volume of water to generate 12,000 gross water horse power in the contiguous hydro-electric plant.

The intake is one of the most outstanding features of the canal system. It taps the Rio Grande about 42 miles north of Eagle Pass, in Kinney County, where a rock channel has been cut at an elevation of approximately 10 feet below the normal low-water level of the river. This intake is concrete lined and has a base width of 40 feet. The flow of water, which will be at the rate of 1,800 cubic feet per second, will be controlled by three 10x16-foot Broome head gates set in a triple-tubed reinforced-concrete tunnel. A sluice channel, controlled by four 4x6-foot gates, will facilitate desilting the intake channel. This provision is essential because of the great amount of silt carried by the Rio Grande.

Where the combined power-and-irrigating



lining the irrigating canal where it goes through rock formation.



Monighan stepper dragline at work on a dirt section of the canal. Harvey Patterson, San Antonio

canal is in earth and is to be lined with concrete it will have a base width of 32 feet, side slopes of 1 to 1, a water depth of 10 feet, a lined freeboard of 1½ feet, and a gradient of .0001 foot per foot. This gradient will produce a velocity of 3.9 feet per second and a flow of 1,600 cubic feet per second. Unlined earth sections have a bottom width of 42 feet, side slopes of 2 to 1, a water depth of 10 feet, a 2-foot freeboard, and a gradient of .0001 foot per foot. The velocity in these sections will be 2.54 feet per second, and the water will have a flow of 1,575 cubic feet per second.

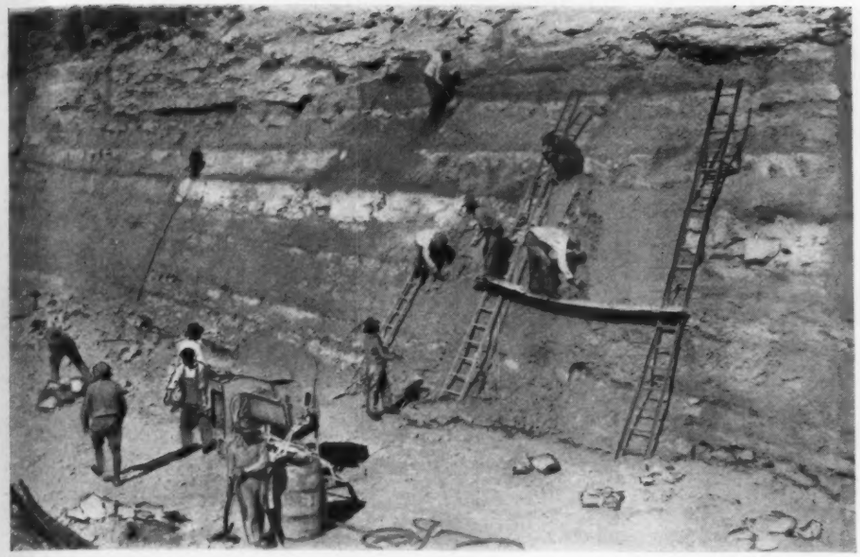
Lined sections in rock have a bottom width of 26 feet, side slopes of 6 inches horizontal to 1 foot vertical, a water depth of 10 feet, a lined freeboard of 1½ feet, and a gradient of .0002 foot per foot—insuring a velocity of 5.06 feet per second and a flow of 1,575 cubic feet per second. All rock sections are lined with "Gunite". Where the canal intercepts large streams it is being carried through the water beds in triple-barreled, reinforced-concrete inverted siphons, each tube of which has a diameter of 10.5 feet and will permit a flow of 553.3 cubic feet of water per second. Drainage from small ravines will be passed under the canal by means of suitable reinforced-concrete box-and-pipe culverts. The 32-mile section of the upstream end of the canal between the intake and the power house site is to be finished before November 1 of the current year. Thanks to the rapid progress already made, there is every reason to believe that the schedule will be met.

Below the power house the canal sections are reduced because the required flow is diminished to volumes ranging between 627 and 392 cubic feet per second. The lower section includes, among other features, a 5,000-foot single-tube siphon, 10½ feet in diameter, and two flumes. All highways are carried across the canal by means of suitable timber bridges. The following major quantities are mentioned to give a clearer grasp of the magnitude of the project. The undertaking involves 12,000,000 cubic yards of earth excavation and 700,000 cubic yards of classified rock excavation, as well as the handling of 1,300 tons of reinforcing steel, 27,500 cubic yards of concrete, 1,900,000 square feet of "Gunite" canal lining, and about 12,000 feet of reinforced-concrete pipe.

The building of the power section of the canal was sublet by Ulen & Company and the District to The Trinityfarm Construction Company, of Dallas, and to Bart Moore, Inc., of San Antonio, who formed a combination for the job. The Trinityfarm Construction Company engaged to do all the earth excavating; the combination undertook to do the rock excavating and lining; and to Bart Moore, Inc., was assigned all structure work. Subsequently the rock excavating was sublet by the subcontractors to Barker Brothers and W. H. Denison, and the guniting was sublet to the Gunite Concrete & Construction Company, of Kansas City, Mo. The latter is engaged in placing about 1,900,000 square feet of "Gunite" lining, 1½ inches thick, reinforced with galvanized welded fabric. In doing this work the Gunite Concrete & Construction Company is utilizing one 14x10-inch, Class ER-1 Ingersoll-Rand compressor and two Type 20 Ingersoll-Rand portable compressors—one 10x8-inch and one 12x8-inch, the latter being designed especially for cement-gun service. These machines furnish air to two N-2 cement guns and one N-1 cement gun.

Centrally located sand and cement mixing plant.

In preparing the "Gunite", dry sand and cement are mixed in the proportions of one part of cement to four parts of sand; and one sack of cement, when applied, covers 30 square feet with "Gunite" 1½ inches thick. About 4 gallons of water are required per sack of cement. The dry sand and cement are delivered to the cement gun and forced by pneumatic pressure through the hose to the point of ejection, where hydration takes place in a specially constructed nozzle body. With water at a pressure of approximately 20 pounds above that of the operating air, it is possible to provide a sufficient volume of water to wet the mixed materials. The cement and sand are blown forcibly against the surface to be coated; and this impact serves to effect a perfect bond with the supporting



Ulen & Company

Filling back break with caliche mud before shooting "Gunite" into place.

base and, at the same time, to build up the "Gunite" to the desired thickness.

The company maintains central mixing plants at convenient locations on the slope of the ditch from whence the materials are loaded in trucks and hauled to the cement guns. These mixing plants are usually placed in the middle of a given rock cut; and the work of shooting the "Gunite" proceeds from both ends towards the middle—the equipment being taken out of the ditch to shoot the final connecting portion. Water for the hydration of the "Gunite" and for its curing is obtained from the Rio Grande, which is not more than a mile and a half away anywhere along the line. The water is pumped to the points of use. The work immediately in hand has to do with the main canal; and the construction of laterals to the 2,050 farm areas planned will be taken in hand later.

The full development of the Maverick County District has been given careful study; and there is every reason to believe that its consummation will lead to the rapid upbuilding of the region and to the prosperity of the countryside adjacent to Eagle Pass. It is worthy of emphasis that Maverick County counts upon coming into her economic own by adapting on a modern scale and by building with up-to-date facilities a system of irrigation devised by the Indians of the region centuries ago. Thus the engineer of the present borrows from the successful performances of the remote aborigines. We sometimes wonder what is really new under the sun?

If information from Bethesda, England, be correct, then roofing slate can be laid intact, that is, without the need of holing it. This is made possible, so it is reported, by a new type of nail having two opposing wings at the top and at right angles to the stem. These nails are driven alongside the slates, and two or more may be used, if desired. Slate chips fairly easily, and holing it preparatory to laying it not only takes time but may be the cause of breakage. Obviously, the new roofing nail is of advantage in more ways than one.

INTERNATIONAL CONFERENCE ON BITUMINOUS COAL

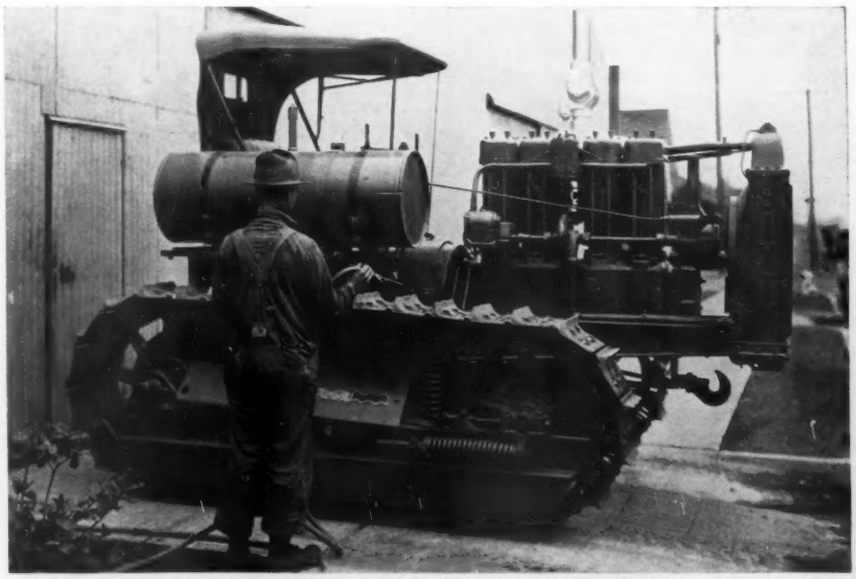
THE third international conference on bituminous coal is to be held in November of this year at the Carnegie Institute of Technology, Pittsburgh, Pa., according to an announcement made by President Thomas S. Baker. The purpose of the congress is similar to that of the 1926 and 1928 meetings—that is, to present for discussion the results of recent studies of coal. Particular attention will be paid to the economics of the new methods and processes that are being evolved. The program will include papers on carbonization, liquefaction, and gasification of coal; on coal by-products and their preparation for the market; and on pulverized fuels, power plants, and domestic heating.

COMPRESSED-AIR UNIT FOR STARTING PLANES

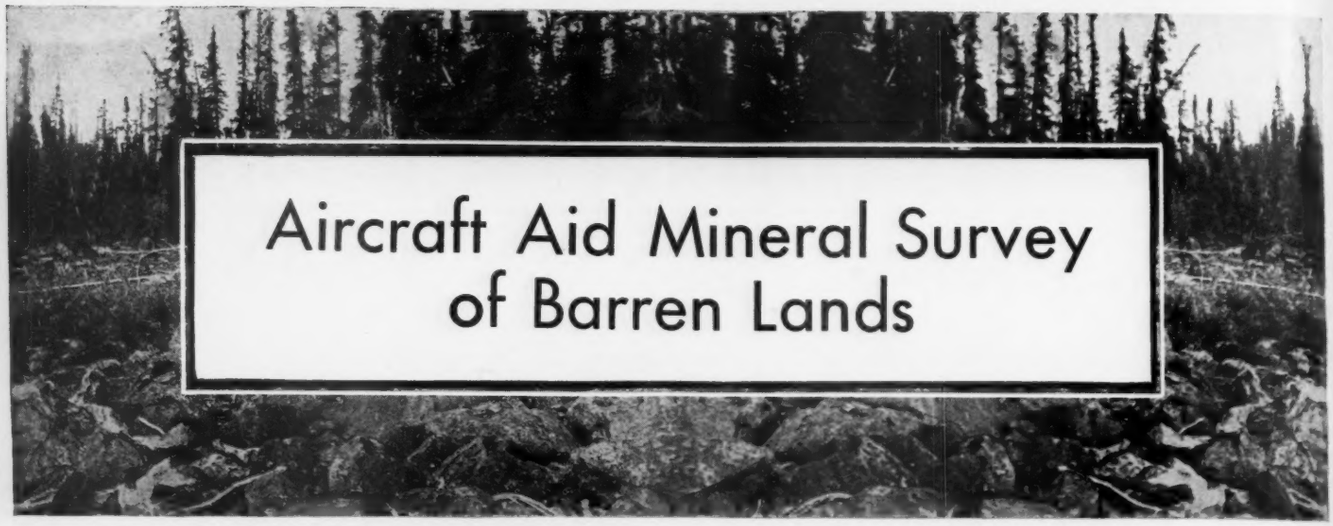
BY means of a new air compressor, which has just been perfected in England, it is possible to start up airplane engines without any difficulty. The apparatus adds less than 10 pounds to the weight of the equipment; is manually operated; and when fully charged should afford pressure for four starts. It is a very compact unit and has a detachable pump handle so that it can be installed in a variety of positions. A wide field of application should be found for it among airplanes that have to operate away from properly equipped bases.

The apparatus consists of a twin-cylinder pump that can be worked by one man and is guaranteed to raise the pressure in a standard air bottle of 390 cubic inches to 200 pounds per square inch in about fourteen minutes. A pressure of 100 pounds can be obtained in four minutes; and as the average 500-hp. engine can be started with a pressure of 75 pounds, a single charging should suffice in the majority of cases. The pump is made of light alloy castings and forgings, and has steel cylinder liners to maintain the initial high efficiency. In the interests of simplicity and reliability the usual inlet valves have been replaced by ports in the cylinder barrel that are uncovered at the end of each suction stroke by the piston.

There are two discharge valves of the duplex ball type in each cylinder, and as these are independently operated there can be little risk of failure. All working parts are lubricated through the main axis bolt—the crank and connecting rods being drilled to allow of central lubrication. In tests the pump has given excellent results; and it should prove valuable because of the necessary abandonment of the difficult method of cranking airplane engines manually.



Before a tractor is turned out of the San Leandro, Calif., plant of the Caterpillar Tractor Company it is cleaned with compressed air which removes in short order the dust and dirt from the otherwise inaccessible parts.



Aircraft Aid Mineral Survey of Barren Lands

Recent Aerial Prospecting in This Sub-Arctic Region of Canada Has Disclosed Areas Rich in Copper and Pitchblende

By W. M. GOODWIN

THE last great fastness of nature on the North American continent has been reduced. During the past three years the Northwest Territories of Canada, amounting to about two-fifths of the country's area, have been viewed in detail for the first time by white men. All that was known previously about the interior of this vast area was what had been seen by intrepid travelers along wide-spaced canoe routes; and only the most skillful and the most daring had made these journeys.

This conquest of Canada's Arctic and sub-Arctic hinterland has been made possible only by the use of airplanes. With their aid, more has been accomplished in three short years than for a century and a half before. This is illustrated well by the experience of one of those engaged in the work both before and since the advent of travel by air. Guy H. Blanchet, exploratory engineer for the Department of the Interior at Ottawa, has spent 25 years delving into the secrets of the north country. For 22 years he worked on its outskirts, being able each season to penetrate only comparatively short distances into the region from Hudson Bay on the east, Great Slave Lake on the south, and MacKenzie River on the west. During the last three summers he has coursed over the interior practically at will by the air routes, and a vast store of new information—most of it general but some of it in detail—is the result.

Mr. Blanchet and others who have shared with him the exhilaration of these first glimpses of this new land are, almost to a man, enthusiastic about its future. The economic possibilities of the region were first brought definitely to the attention of the Canadian people by Vilhjalmur Stefansson, who twenty years ago advocated the cause of the northern plains, saying they would support vast herds of reindeer from which an important supply of meat could be derived. His insistence has won out against both inertia and antagonism, and today a large herd of reindeer, bought by the Canadian Government from a successful breeder in Alaska, is being driven by easy stages toward an area east of the MacKenzie River delta, which has been surveyed and found suitable for them. If the experiment succeeds, the so-called "barren lands" may in time support herds of reindeer much as the prairies supported the buffalo before the white man killed them off.

Travelers in the Northwest are unanimous in condemning the use of the term "barren lands" to describe the treeless expanse that stretches from the shore of Hudson Bay to Great Bear Lake. The name was applied first, no doubt, by men accustomed to the wooded country that adjoins it on the south and west; and the gradual emergence from the forest on to the open spaces would doubtless give the ground a bare appearance. Besides, there is a great deal of solid rock outcropping in places, while in other sections there are long expanses of boulders and gravel that cannot support vegetation. Locally, the name may therefore have some justification: in general, however, this sub-Arctic plain is clothed during the short summer with a luxuriant growth of flowers and herbs, and, wherever there is enough shelter from the winter winds, the Arctic shrubs push up as far as they dare. The winter?—Well, that is another story. For present purposes, the winter is simply a long time of waiting until the spring brings the next opportunity for travel and exploration. And in comparison with other northern latitudes, the only serious disability during the winter is the lack of fuel supply.

Apart from the possibility of raising reindeer herds and of growing crops for local needs during the brief summer, the only economic attraction in the Arctic prairie is its minerals. During the seasons of 1928, 1929, and 1930 a beginning was made in exploring it, and the results are so promising that the work is sure to be continued for some years to come.

The easiest approach to the Arctic plain is via Hudson Bay. That is the way three expeditions entered it in 1928—two by vessels through Hudson Strait, and the third, on a smaller scale, by the time-honored canoe route. The latter, with small boats alone to aid the journey, had the best luck, and the Cyril Knight Prospecting Company has today a nickel deposit on Ranken Inlet that is of economic dimensions and grade and awaits only a market. It was diamond-drilled last summer, and is the first proven deposit of the region.

Courtesy, Department of the Interior, Ottawa

Thelon Game Sanctuary, an area of 15,000 square miles, in the central part of the Northwest Territories.

The Dominion Explorers and the Northern Aerial Minerals Exploration expeditions of 1928 were made to investigate the known mineralized area northwest of Hudson Bay. Both were completely provided for an eighteen months' stay, and had airplanes as well as the usual land equipment. Fuel for the 'planes and for the dwellings composed the larger part of the cargoes of both vessels—there being no fuel but driftwood in that region where the natives use blubber lamps to warm their igloos. Caches were established at strategic points; and, in spite of the shipwreck of one of the boats, the prospecting parties were well provided for two seasons' work.

The known mineral occurrences reported by earlier explorers were around Chesterfield Inlet and Baker Lake, leading inland from the northwest coast of Hudson Bay, and in the vicinity of Bathurst Inlet, which is 500 miles to the west off Coronation Gulf. The airplanes coursed over these parts of the territory, landing prospectors wherever there was evidence of mineral deposits; and a very large area was thus subjected to a preliminary examination. As any prominent feature—such as a quartz vein, a gossan, or even a long depression in which a vein might lie concealed—stands out prominently when viewed from the air, it became obvious at the end of two seasons' work that no large deposits easy of discovery were to be found in this region. The prospectors said that the ground was too "tight", and the geologists attached to the expeditions corroborated this view, but in different terms.

Courtesy, Department of the Interior, Ottawa

Some of the hardy musk oxen still to be found in the Northwest Territories.

One of the special objects of the search around Bathurst Inlet and farther west on the Coppermine River was the native copper that was reported by Samuel Hearne in 1772 and by Sir John Franklin a century ago. It was discovered that, while there are occasional large lumps of copper associated with the copper-bearing trap rock, the average content of the rock wherever it is exposed is much too low to be of value. But these lumps of copper, picked up from the drift rock, have served the needs of the Eskimos for centuries past. One enterprising old native had established a primitive hardware store by pitching his habitation over a large lump of copper and trading pieces hacked from it for food and other necessities brought by his customers.

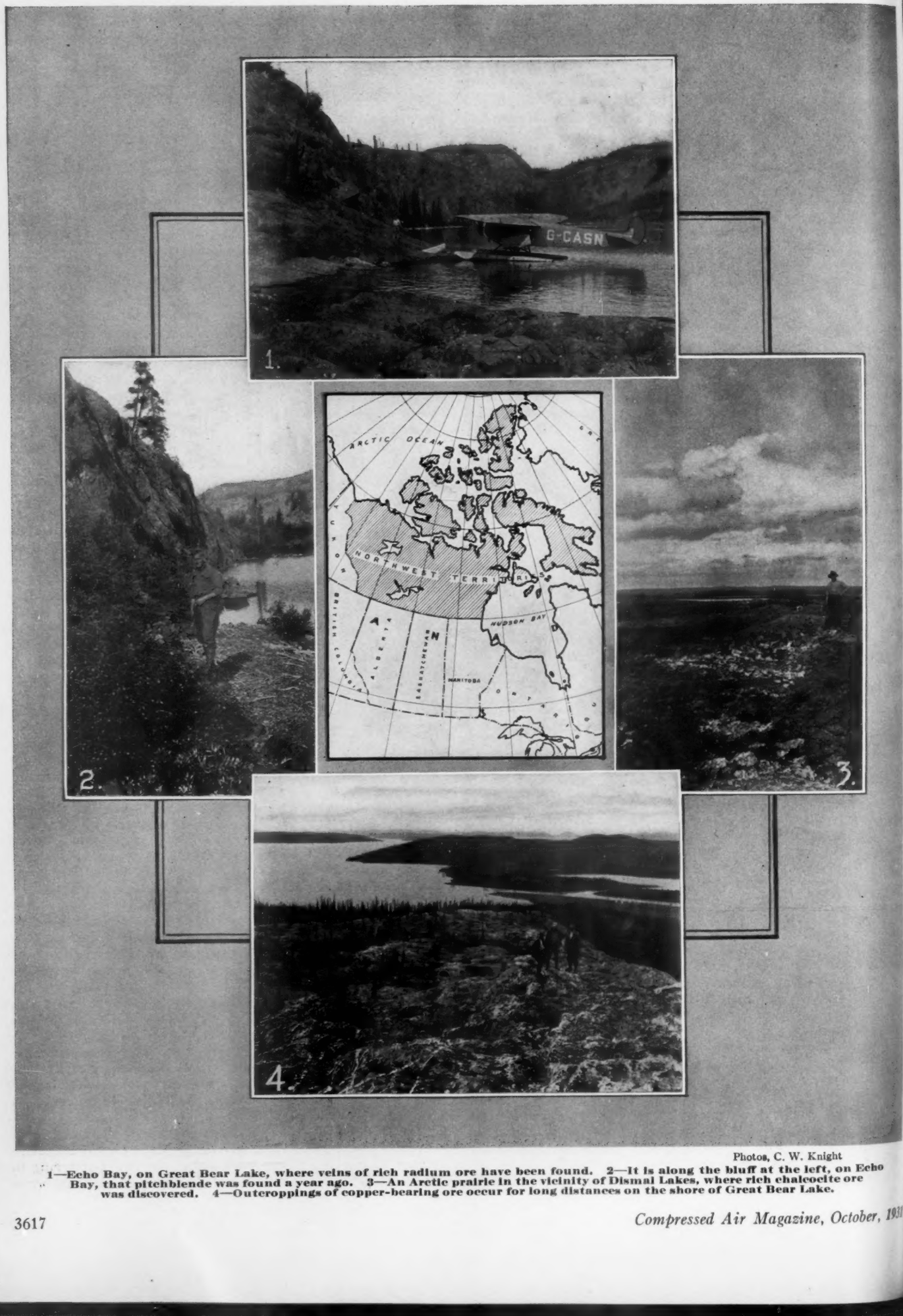
During 1930 the prospecting luck changed; and it looks much as if the finds made then will result in due course in a consistent mineral production from the region. It had been noticed during aerial traverses and preliminary examinations on the ground during the previous season that the rocks east and northeast of Great Bear Lake appeared more promising as to minerals than any that had been seen up to that time, and some occurrences of minerals were also noted by the prospectors. Consequently, the Dominion Explorers and the Northern Aerial Minerals Exploration Company concentrated their efforts on this district, and both made discoveries which, if within reach of the railways, would have been hailed as presaging the establishment of important copper camps. As it stands, some of these finds are extremely interesting and may prove to be of sufficiently high grade and large enough to support profitable operations even in that remote locality.

The copper occurs as bornite and chalcocite in veins ranging from stringers upwards to substantial widths. In some of these veins the copper mineral is massive: in others disseminated. The two companies named centered their detailed work on two areas 100 miles apart. Dominion Explorers discovered numerous copper showings around Hunter Bay, on the east side of Great Bear Lake, and on islands in the lake, and their engineers report encouraging results. The Northern Aerial Minerals Exploration Company settled finally on the Dismal Lakes district, only 40 miles from the Arctic coast, where a number of small veins of massive chalcocite and bornite, in addition to some larger veins of disseminated minerals, proved very attractive. They finally found massive bornite float in a draw in considerable quantity and about 2,000 feet in length. Trenching was very difficult, due to the fact that only a foot or so of the surface thaws during the summer; and any excavation extending beneath this depth acts as a sump for the water from a large area round about. In spite of this difficulty one trench was put to bedrock partway across the draw, and it showed 12 feet in width of massive bornite that averages 47 per cent copper—almost theoretically pure bornite.

The most startling discovery of the year, however, was some little veins only a few inches wide composed of pitchblende with an unusually high content of radium. The Labine brothers of Toronto, newcomers to the field, found these veins on the shore of Echo Bay on the east side of Great Bear Lake and about 35 miles south of Hunter Bay. They brought out some hundreds of pounds of the pitchblende, a part of which was subjected to careful tests by the staff of the Department of Mines in Ottawa. If the content of these samples is at all representative of that of the veins at large, the material can be hand cobbed to a concentrate worth about $5,000 a ton at the present price of radium. It is obvious that mineral of this value could stand a very high charge for transportation; so if it is proved to be available in any appreciable tonnage it is more than likely that facilities will be provided to ship the ore to civilization, probably by vessels coming during the short summer through Behring Strait and the Arctic Sea to Coronation Gulf, 150 miles to the north.

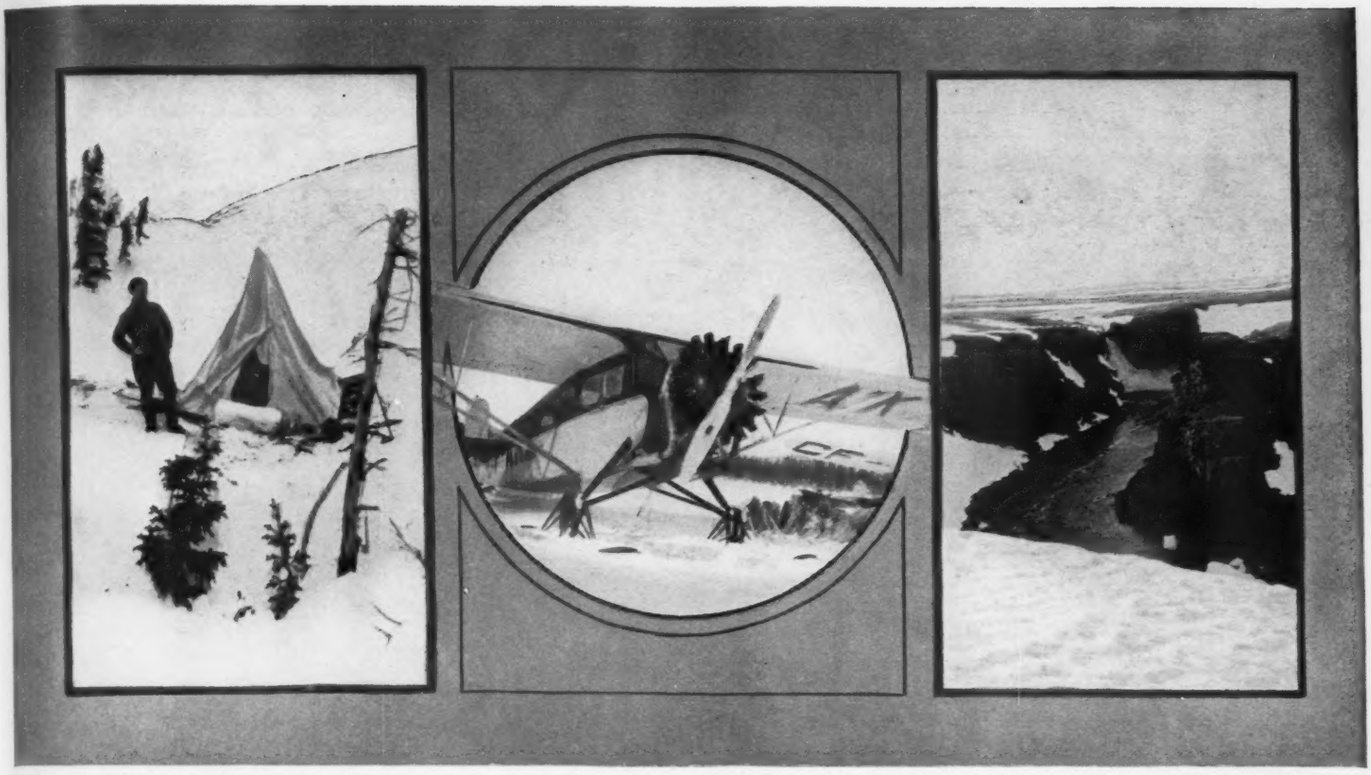
Early during the present season work was commenced on some of these discoveries of the previous season. While the ice was still on the northern lakes and the ground frost-bound, the 'planes of the Northern Aerial Minerals Exploration Company left their base at Sioux Lookout, Ontario, on their long flight to Dismal Lakes, equal to half the distance across Canada. They landed a party of prospectors with supplies and equipment to trench across the high-grade vein of bornite while the frost still held the waters. As this locality is in the treeless belt, it is necessary to bring in fuel, and tents are the only feasible shelter. The airplanes came out when their transportation job was finished; and the party has been at work since March and will continue until early fall. If luck is with those men they will uncover in their trenches across the 30-foot draw the richest concentration of copper the world has ever seen. There is evidence that the mineral occurs beneath this draw for 2,000 feet or more; and if the float ore and the few exposures made in last year's trenches prove to represent the average grade, this one vein may make one of the large copper producers of the world. Forty miles by tractor to the coast and the cost of ocean carriage through the Arctic and Pacific oceans to a smelter will impose no serious burden on ore averaging more than 40 per cent copper.

The Labine brothers have also had a party at work since early spring stripping the pitchblende veins already found and trenching to locate others. Their situation on the shore of



Photos, C. W. Knight

1—Echo Bay, on Great Bear Lake, where veins of rich radium ore have been found. 2—It is along the bluff at the left, on Echo Bay, that pitchblende was found a year ago. 3—An Arctic prairie in the vicinity of Dismal Lakes, where rich chalcocite ore was discovered. 4—Outcroppings of copper-bearing ore occur for long distances on the shore of Great Bear Lake.



Left—This cheerful picture was taken in the month of May near Dismal Lakes. Center—Airplane used in carrying supplies to prospecting parties from railway base 850 miles away. Right—Coppermine River just after freeing itself of ice in the early summer.

Great Bear Lake offers more comfort than that of the Northern Aerial Minerals Exploration group 100 miles to the north, for spruce woods, though rather sparse compared with the thicker forest along the Mackenzie River, surround the lake providing fuel and a reasonable amount of shelter. Shortly after the Labine party arrived on the ground in April, word came through that they had found another vein of pitchblende; but this news has not yet been affirmed.

The properties of the Dominion Explorers have not been so readily amenable to surface trenching, so it has been arranged recently to diamond-drill some of their finds of last summer. As the rock is permanently frozen for some hundreds of feet beneath the surface in this latitude, it will be necessary to heat the feed water of the drill to prevent it from freezing in the hole. With wood fuel available on the spot, the exhaust from a light steam-driven machine will serve this purpose readily.

A number of prominent Canadian geologists and engineers accustomed to sizing up mining prospects in a practical and all-around way, have already visited the Great Bear and Dismal Lake sfields. The concensus of opinion so far is that it will be entirely practicable to mine and to ship ore from these deposits, provided it is rich enough and the amounts are large enough. The experience of those accustomed to life in these northern parts of Canada shows that the climate will present no serious difficulty to mining operations. Ocean-going vessels already ply each summer along the Arctic Coast, bringing supplies to the various posts and taking out the furs, thus providing a means of transportation to and from any property within reach of the coast.

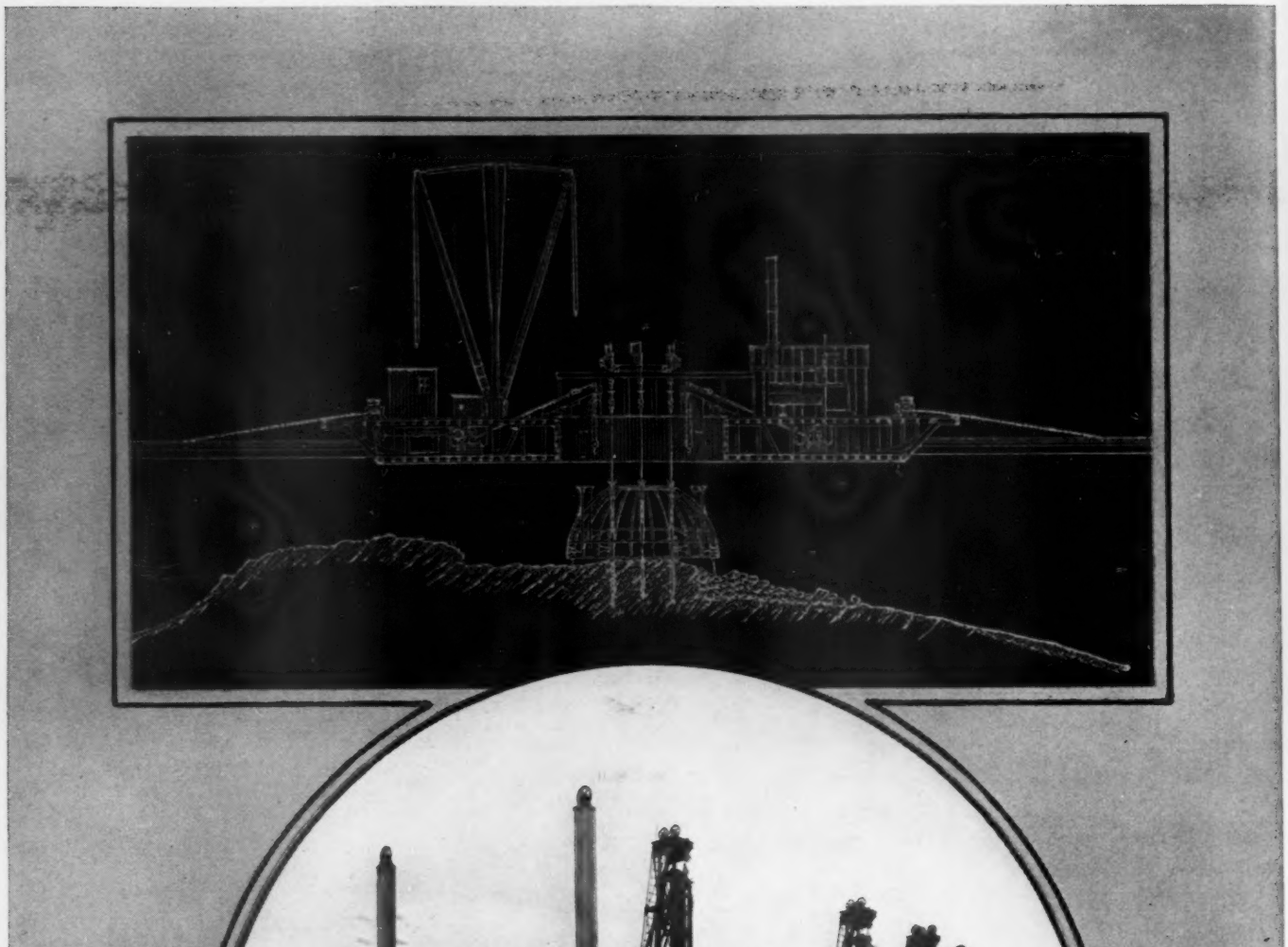
It has been found that the Arctic prairie, when frozen, offers an admirable surface for travel by tractor, so that the distance from the coast at which a mine can be operated profitably can be measured by the cost of tractor haulage. It is worthy of note in this connection that the silver-lead ore of Mayo, in the adjoining Yukon Territory, is all hauled 40 miles by tractor before being loaded on river steamers for the 1,000-mile journey to the sea. Meantime, freight for development purposes is being carried on the regular steamers down the Mackenzie River to Fort Norman, at the mouth of the Great Bear River, thence in smaller boats to Great Bear Lake, and across the latter in sailing vessels capable of withstanding the weather on its wide expanses. It must be remembered that Great Bear Lake is one of the largest bodies of fresh water in the world, being close on to 300 miles long.

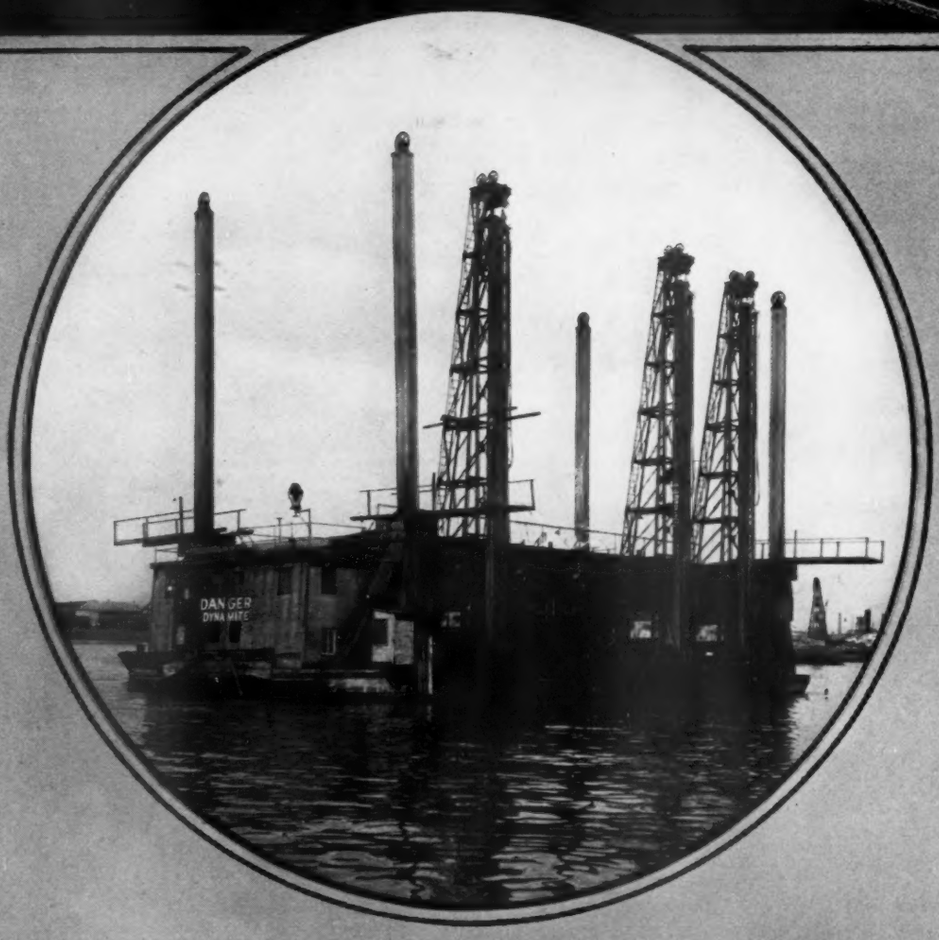
It is thus perfectly reasonable to envisage, a few years hence, a flourishing mineral industry in the Great Bear Lake district. The output will be small, but extremely valuable. Cargoes of ore will reach the coast at Coronation Gulf during the winter in tractor trains, which will carry on their return trips the fuel oil, coal, and general supplies required by the mines for the year to come and brought by the vessels that take away the ore. The mine staffs and crews will be of that adventurous type that already is to be found in the mines of the Yukon and Alaska—mines similarly circumstanced and in the same latitudes. Mail and passenger service will be furnished bv airplanes, as at present, and another wireless station added to the growing number already provided by the Canadian Government will give continual communication with the world at large. But all this depends on the luck of the handful of prospectors now at work astride the Arctic Circle. Here's hoping they will succeed in establishing firmly another outpost of civilization.

FULLY EQUIPPED ROLLER-BEARING TRAIN TESTED

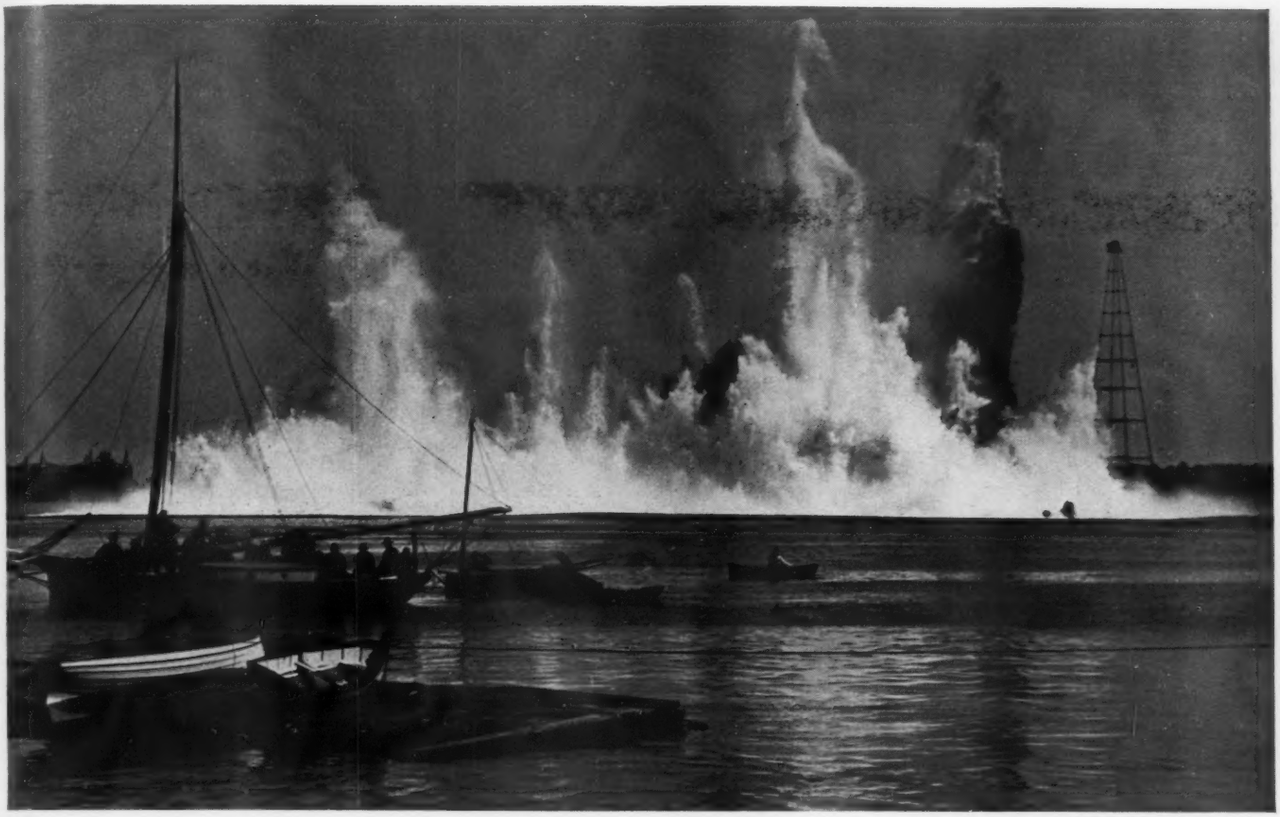
THERE is every indication that the railroad rolling stock of the future will be equipped with roller bearings for smoother and faster running than is possible under present-day conditions. The fact is that pioneer work of the Timken Roller Bearing Company culminated not long ago in a successful test run over the New York, New Haven & Hartford of its Merchants' Limited, which was equipped with roller bearings from end to end. The train was made up of twelve Pullman cars and two diners, and was pulled by a locomotive especially built for the Timken Roller Bearing Company to determine the value of roller bearings in railroading.

Prior to this test run, the locomotive was used by the New Haven in its regular freight service, handling 150 cars and a load of 7,630 tons with ease, and for the most part unassisted. In commenting on the trip of the all-roller-bearing Merchants' Limited, the general mechanical superintendent of the system said: "The locomotive performed very satisfactorily, steaming well—all boxes and rods running cool. Eight tons of coal and 15,200 gallons of water were consumed from New Haven to Boston, a distance of 157 miles."





Top—Drill rig designed in 1867 by the late Brig. Gen. John Newton, U. S. Army, for the removal of subaqueous rock in Hell Gate. Bottom—The up-to-date drill boat "East River" owned by the Arundel Corporation and engaged in widening and deepening the Kill van Kull near Carteret, N. J.



Ewing Galloway, New York

The monster blast that shattered Flood Rock in Hell Gate on October 10, 1885, and cleared the way for deep-draft vessels using the East River.

Progress in Drilling Subaqueous Rock

The Art of Drilling Submarine Rock Has Experienced Many Changes in Bringing It to Its Present Efficient Status Under Varying Conditions.

PART I

By CHARLES C. HANSEN

DRILLING rock underwater has followed in a general way the evolution of the drilling of rock clear of water. That is to say, developments in the art of subaqueous drilling have differed in the main only in those respects that one would naturally look for in working through an obscuring medium and, as a rule, from a floating base. Because of these restrictive or hampering circumstances special facilities have been devised to enable the rock drill to do its work efficiently and precisely. No small measure of inventiveness and engineering skill has contributed to the success attained.

Removing rock underwater, according to earliest records available, was accomplished by bouncing up and down a long bar of iron—the striking end being sharpened to a point or cone so as to split or fracture rock strata by repetitive impacts. Before this method was abandoned, the bars became very heavy, weighing as much as 3 or 5 tons. Bars of this sort were effective only against soft and stratified formations. Against solid rock, or hard flat formations, the bars made but little impression, and their use was expensive and their action slow. However, those pioneer efforts served a purpose, and they led to the designing of better machines, which were built and used especially in Europe. The rock encountered in digging the Suez Canal was cleared away with a Lobnitz breaker; and one of those machines was equipped to handle a bar weighing as much as 19 tons.

Upon the same principle the United States Army Engineers, in 1872, designed and built what was termed a "chisel boat". That craft was constructed to remove rock in the Mississippi River, at Rock Island Rapids, that obstructed navigation for a distance of fourteen miles. The vessel was in service up to 1889. This date is interesting because it reveals how long the art of drilling rock under water remained unaltered in principle—the only material advance being in degree and in the betterment of some of the contributive mechanical features. No explosive was used at that time; and the rock shattered by the chisel was subsequently excavated by a dipper dredge. When the point of the chisel was dull, that tool, weighing from 3 to 4 tons, had to be shipped to Chicago for resharpening—the chisel boat in the meanwhile being inactive.

With the invention of dynamite in 1867, and its perfecting later, an explosive became available that could be used underwater, as well as on land. Up to that time rock clear of water was drilled by one man holding and turning a drill steel while one or two others struck the steel with sledges—a slow and exhausting operation. Between 1848 and 1874, the steam-power rock drill was invented and gradually improved by Joseph W. Fowler, Charles Burleigh, Herman Haupt, Volsen Wood, Simon Ingersoll, H. C. Sergeant, J. B. Waring, and J. C. Githens, about in the order named. The surviving types produced by Sergeant and Githens made the steam-power drill practical and successful. Those machines were what are called piston drills, that is, with the steel clamped to the piston rod of the drill; and they were built so as to operate either with steam or compressed air. Because of the great savings in cost and time over hand drilling, the steam-power drills made it possible to do work never before practicable. About the same time dynamite

Ewing Galloway, New York

Hell Gate of today. The removal of many thousands of cubic yards of submerged rock transformed this erstwhile dangerous stretch of the East River into a deep and safe channel for all kinds of shipping.

was adopted as a standard explosive in breaking rock.

The success of piston drills in drilling rock on land made it natural to try to do similar work with those drills on submerged rock. Standard land drills set up on rafts or barges and mounted on tripods were tried in drilling small areas of rock situated usually in shallow water. It was difficult to hold these floating bases in a fixed position when drilling, and, therefore, "anchor spuds" were devised. These spuds, then as now, were long sticks or timbers supported in guides, one at each corner of a raft or barge, and arranged so that a small part of the dead weight of the craft could be transmitted to each spud.

At first, this distribution of the load was accomplished with blocks and tackle, operated by hand, but, later, steam engines did the work by means of a pinion engaging a rack secured to each spud. Still later, powerful hoisting engines made the transfer with wire ropes led over sheaves fitted on the spuds. After the spuds rested on the water bed, the vessel was raised on the spuds high enough to deliver some of her dead weight to them, and that steadied the spuds so that the boat would remain stationary against the sweep of tidal currents. An early example of this system was the platform method designed by the late W. L. Saunders, in which a raft or platform was suspended or lifted out of the water on four anchor spuds. The raft was completely out of water at high tide.

Rafts were used for the first time in removing Black Tom Reef in New York Harbor in 1881. The telescopic mud pipe then devised for excluding mud and sand from a drilled hole until loaded is used today without much change in construction. On the Black Tom Reef job the drills were mounted on tripods on a flat A-shaped frame, on which the tripod legs rested. This permitted the drill and mounting to be easily moved to a new position on the deck after a hole had been finished and loaded.

On the Great Lakes, from Buffalo to Duluth, the rapid increase in traffic first demanded a channel 9 feet deep. By degrees this depth was increased to 24 feet. There is a demand now for a channel 27 feet deep. Work on the Great Lakes gave birth to what is known as the submarine drill boat, designed to clear away rock obstructing navigation at numerous points. In the beginning, tripod drills, such as those then used on land, were employed; but, as larger and larger contracts were let, gradually more complete and bigger drilling plants were required to do the work within the time limits set.

In many places the areas to be excavated were exposed to wind and weather, and larger boats were needed to operate under such conditions. This situation forced the designers to find ways to cheapen and to hasten the work. This caused them to turn to bigger drills, inasmuch as heavy drills were not as objectionable—because of unhandiness in moving—as such drills were in land drilling. At first, the drill with shell was mounted in a wooden frame, and was controlled by feed screw and hand crank. The backing was so arranged that it could be raised or lowered in the derrick to make the feed longer or shorter, as desired. This was slow work, because after feeding the heavy drill about 2 feet it had to be cranked back; the backing lowered 2 feet and fastened; and then drilling had to be resumed and continued for 2 feet. This procedure was repeated until the hole was down to the desired depth. Rock drills with automatic feed were later used to relieve the heavy work of feeding and to make this operation more accurate than when performed by hand. These drills were employed in an effort to eliminate the skilled operator. We have described only some of the steps taken in the development of submarine-drilling machines.

United States Army Engineers built and put in commission at Rock Island, Ill., in 1889, the first Government drill boat patterned on the lines developed on the Great Lakes; and a second craft of this sort was put in service in 1893, employing hand-screw feed and anchor spuds operated with hand winches. The first boat was equipped with two drills and the second one with three drills. The drills covered a distance of 54 to 72 feet along one side of a vessel. From 16 to 24 holes were drilled and loaded before a boat was moved out of the way for blasting. The cost of breaking rock with these drill boats was only one-third of that when doing the work with a chisel boat.

In the meantime improvements were made for handling contracts on the Great Lakes. There new drill boats were made that were handier and easier to move. They had steam-power hoists to operate the anchor spuds and spring lines, and they had hydraulic feed for their drills. Efforts were made to reduce the time that the drills were not actually attacking rock. The drills were improved, made larger and heavier, and were mounted on steel plates or slab-backs; they were guided in drill frames, were lifted and lowered by hydraulic cylinders which were placed directly behind the slab-back in the drill frame, and had a feed or lift of from 12 to 19 feet.

The drill frames were commonly mounted on one side of the boat and could be moved along that side on stringers or rails. In this way a line of holes was drilled for a distance depending on the length of the boat. Two to three drills were the usual number on each

boat, but later the drills were increased to four or five when the hulls were built longer and larger. This was an effort to reduce the cost of drilling. In the beginning the towers were moved with crowbars and hand winches, but later this was done with steam and hydraulic cylinders which operated an endless chain that could be attached by different means to the bottom of a drill tower.

Drill frames of steel in time supplanted those of wooden construction. The steel frames were lighter and more rigid than wooden ones as the height increased with the use of drills having longer lift or feed. Similarly, boats with steel hulls took the place of the earlier wooden craft; and in this respect followed shipbuilding progress on the Great Lakes. Steel hulls made it possible to drill and to fire each hole without moving the boat: in places where the water was fairly deep and where "range-shooting"—that is, the simultaneous firing of several holes was not permitted, single-hole firing had its advantages. Drills, by that time, were built having a 5½-inch bore and an 8-inch stroke; and some that were especially constructed had a 6½-inch bore and a 9-inch stroke. This represented an increase from a 4-inch bore, and was due to the increased depth of channels and the use of longer and heavier steels.

In the early days of submarine drilling the work was done only by daylight, but as improvements were developed the working period was lengthened to two 11-hour shifts daily. Subsequently the change was made to three 8-hour shifts. Along about 1907, the hydraulic feed was altered to wire-rope feed which was handled with steam hoisting engines. The advantages were: longer lifts than with hydraulic cylinders in the same height of tower, and a possible longer working season because the water in the hydraulic cylinders was apt to freeze in cold weather.

A heavy block or crosshead—usually a casting with sheaves in a pocket for the hoisting rope—was guided in the derrick. To this a drill cylinder was bolted; and this gave the necessary weight to absorb the momentum of the rapidly moving piston and steel. This simple arrangement provided a reliable means of handling the drill; and if anything went wrong with the drill a spare drill could be substituted in a comparatively short time. The number of drills increased to five on some boats. With a boiler to supply steam to all the drills, the hoists, and the winches, and with a blacksmith shop, an electric-light plant, and pumps, these floating plants were pretty complete drilling outfits. The hulls were about 140 feet long, 32 feet wide, and 6 feet deep; and they were divided into a number of watertight compartments. The vessels had coal bunkers that could hold more than a week's supply of fuel.

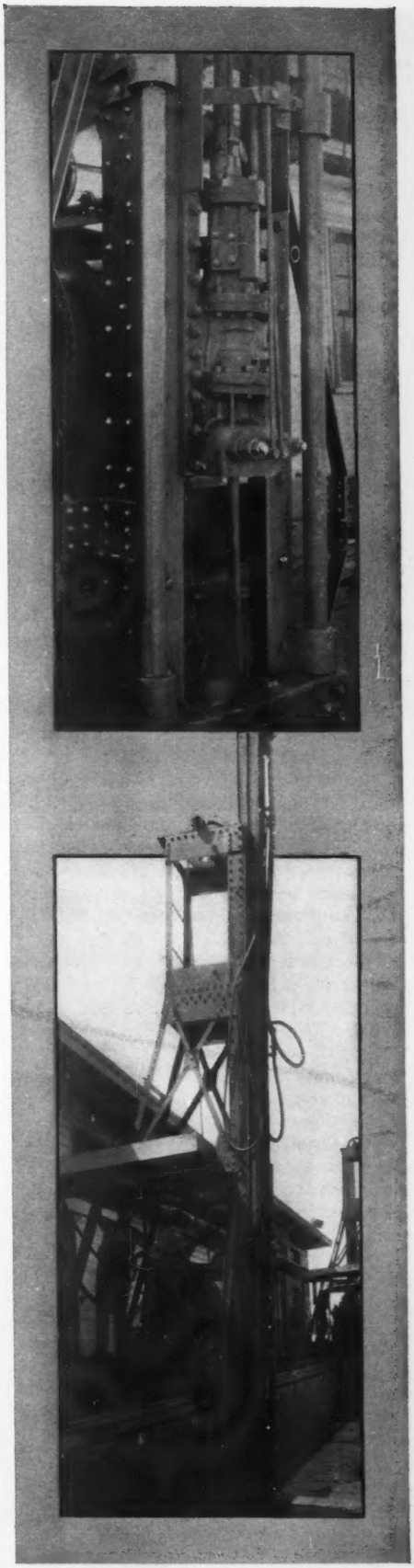
We have seen that drill boats were designed successively to carry increasing numbers of drills on one side, and that the drills could be moved so as to drill a succession of holes before the craft were shifted. There were departures made in several directions in seeking better performances or to meet unusual conditions. An example of the latter trend was the drill boat used in the Galop Rapids, in the St. Lawrence River, where it had to work in a current ranging from eight to twelve miles an hour.

That boat was built with four slots or wells in the after part of the hull, and each of these was 18 feet long and 8 inches wide. Four 5-inch drills worked over the wells. The craft had four anchor spuds, 20 inches square in cross section, which were power controlled and she had heavy winches for handling five 1¼-inch breasting chains, each having a breaking strength of 40 tons. The main problem was to hold the boat in position. The drills were especially designed for the work. They were supported in hinges, much like a door; and heavy pipes could be set and secured in the wells so that holes could be drilled through in the underlying rock.

Another type of submarine drill scow has been in service on the Atlantic Coast. One or two drill spuds are provided that slide in guides on a wooden frame mounted at one end of the vessel. The drill, with screw feed, is fastened at the top of the spud, and the drill runner is in a cage on top of the spud. The scow has no anchor spuds but depends on the two drill spuds and spring lines to hold it in a desired position. The drills have a 10-foot screw feed that is operated by a 3-cylinder steam engine with clutches and bevel gears; and there is a handwheel for feeding the drill when drilling rock. The drills have bores varying from 5 to 5½ inches; and the mounting was designed to meet tidal changes that have a rise and fall of from 5 to 7 feet.

Probably an extreme case in submarine rock drilling was that presented where a small area had to be drilled and blasted for a channel at low tide in the Bay of Fundy, where the difference between high and low water is nearly 60 feet. The contractor solved the problem by mounting the drill frame and the drill on a heavy timber spud, about 75 feet long. The spud was anchored with six or eight spring lines radiating from the top of the spud and connected with as many anchors or kedges. A derrick boat was used to move the spud to a new position at high tide; and the boat supplied the drill with operating steam through a long rubber hose. The cost and the risk were high, but the work was successfully completed.

Tidal conditions along the Atlantic seaboard compelled the contractors to devote much thought to the designing of drill boats that could be operated satisfactorily. For instance, a boat was built with the drills mounted on spuds, all on one side of the craft, so as to give the flexibility of the Great Lakes type of construction. Four vertical guides were mounted on a track suspended about 15 feet above the deck; and this gave a combined travel of 70 feet for the four guides on that single side. In each guide was fitted a drill spud that could be lifted or lowered. Each drill, with feed shell, was fastened on top of a spud, and the drill was shifted vertically by means of a feed screw operated by a 1-cylinder steam engine geared to the screw with clutches. The total feed was about 12 feet. The operator, in a cage on top of the spud, could control the drill by the engine or



One of the X-80 drills on the United States Army drill boat "No. 426" removing rock in the Mississippi River off Rock Island, Ill. Top—Close-up of the drill showing leads and mud pipe.

feed it by hand. When at work, the drill spud rested on the water bed; and the drill boat was able to rise or to fall with the tide on four anchor spuds placed at the four corners of the hull and operated by individual engines.

Because of seasonal slackness of work on the Great Lakes, some of the drill boats on the Great Lakes were towed down to the Atlantic Coast and adapted to meet the changed conditions imposed by deeper channels and tides. The tidal variations were easily overcome by keeping a continual steam pressure on the anchor spud engines—thus insuring at all times the transfer of a certain amoun of hull dead weight to the spuds. With a few minor alterations and the use of longer steels these boats have been able to deal with conditions fairly well.

In 1912, the United States Army Engineers put in commission on the Mississippi River a new drill boat built on the general lines adopted on the Great Lakes. It was equipped to handle the drills with hoisting engines and wire rope instead of hydraulic cylinders. The vessel had a length of 132 feet, a beam of 32 feet, and a depth of 6 feet. It was built entirely of steel; was provided with towers, mounting four 5½-inch drills on one side, and with four anchor spuds, one at each corner; and it used spring lines handled with winches. The boat has proved efficient; and the two old drill boats, built, respectively, in 1889 and 1893, were scrapped. It should be borne in mind that the United States Army Engineers have had to do with all plans and contracts for deepening channels and harbors in the United States or under the control of the Government; and these experts have followed closely the art of submarine drilling and have patterned their own vessels and equipped them so that their performances would be of a high order.

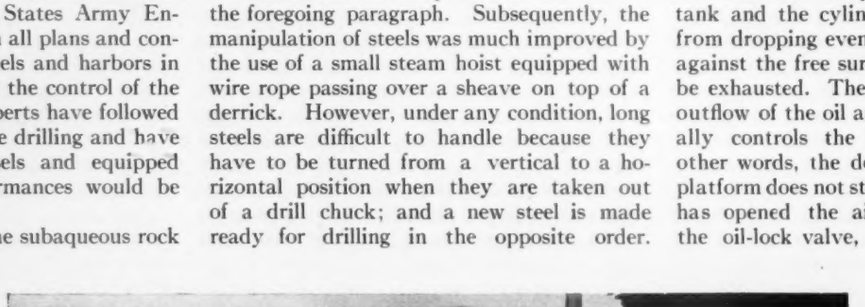
Attention is invited to the subaqueous rock drilling at the Pacific entrance of the Panama Canal. The details of that work are given at some length in Ira E. Bennett's book *History of the Panama Canal*. We quote only one paragraph covering the operation of a single drill boat over a period of 24 months: "During this time the drills worked 22,854 hours (i. e., the total of hours in work on the separate drills) and drilled 286,005 feet of hole of an average depth of 16.5 feet each. The drills averaged 13 feet of hole per drill per hour. The maximum over a period of one month was 21.64 feet per drill hour, and the minimum over a like period 5.9 feet per drill hour. The unit average cost, over a period of twenty-four months of operating, drilling, and blasting, was 39.62 cents per cubic yard."

It should be apparent from what has been stated that the Great Lakes type of drill boat has been able to meet conditions not only on the Mississippi River, where there is no tide, but also on the Pacific side of the Panama Canal where there is a tidal range of 24 feet; and it has used steels up to 65 feet in length and weighing about 800 pounds. While we do not know how these long steels were handled, still the following description of the removal from a machine of a steel 36 feet 9 inches long should be of interest:

"First, the U-chuck bolts are loosened until the drill steel comes out. The drill cylinder is lowered by the hydraulic as low as possible and a chain slipped around the piston rod with its other end wrapped around the steel near the center of its length. The hydraulic is then used to raise the drill and attached until overbalanced. As it then gradually overturns it is caught by five or six men and carried by hand and slipped through a nearby window into the house, where it is handled by blacksmith and helpers."

The foregoing description has to do with operations on the Detroit River 23 years ago; and the weight of a drill steel was then in the neighborhood of 480 pounds. In all likelihood the putting in of a new steel called for a reversal of the procedure outlined in the foregoing paragraph. Subsequently, the manipulation of steels was much improved by the use of a small steam hoist equipped with wire rope passing over a sheave on top of a derrick. However, under any condition, long steels are difficult to handle because they have to be turned from a vertical to a horizontal position when they are taken out of a drill chuck; and a new steel is made ready for drilling in the opposite order. It still requires from four to six men to complete a change, which consumes approximately half an hour.

(To be continued.)



The Curtis pneumatic lift for long-wheel-base motor trucks and coaches.

PNEUMATIC LIFT FOR HEAVY MOTOR VEHICLES

THE work of keeping the steadily increasing fleet of heavy trucks, buses, and motor coaches in condition has been considerably facilitated by the development of a larger and a more powerful model of the pneumatic lift for automotive vehicles that is now to be found in many up-to-date garages for what might be classed as "under-the-car service". The new lift is of the rotary, single-lift type and has a platform length of 23 feet—sufficient to accommodate trucks and single-deck motor coaches that have a wheel base not exceeding 267 inches, the present maximum. It has a capacity of 10 tons at 110 pounds air pressure, and raises the vehicle by the front and rear axles. This leaves the wheels hanging free, thus making for easy brake and wheel adjustments.

The platform is elevated by forcing oil out of a tank into a cylinder—the air pressure required to do this varying with the weight of the load. To assure the safe and reliable functioning of the mechanism there are provided an oil-lock valve and a retard valve. The oil-lock valve is interposed between the supply tank and the cylinder and prevents the lift from dropping even should all the air applied against the free surface of the oil in the tank be exhausted. The retard valve restricts the outflow of the oil and in that way automatically controls the lowering of the lift. In other words, the downward movement of the platform does not start until after the operator has opened the air valve and stepped on the oil-lock valve, both of which are so located that they cannot be accidentally manipulated.

The first of the four polders that are being reclaimed by the Dutch from the Zuider Zee has been pumped dry and is being made ready for cultivation. It has an area of 50,000 acres and represents about 9 per cent of the total area to be drained. The work of pumping was done by two stations having a capacity of 486,000 gallons a minute, and this operation extended over a period of approximately eight months. So far the government is said to have expended the large sum of $75,000,000 on this great project that will eventually add 550,000 acres of farmland to The Netherlands.

Isle of Man
Making Ready for More Visitors

Island's Largest City Has Improvements in Hand That Will Involve Considerable Outlays

WHY, when and how the Manx cat became tailless is still provocative of speculation among persons interested in such matters. But why the Isle of Man is a popular resort for tourists and vacationists is easy to explain.

The island lies in the Irish Sea nearly midway between England and Erin, and about the same distance south of the coast of Scotland. As climates go in that part of the world, that of the Isle of Man is described as equable and sunny; and the air generally is invigorating although inclined to be humid. This dominion of the crown of England is about 33 miles in length, north and south, and at its broadest part it has a span of twelve miles, east and west. Because nature has brought mountain, glen, and sea in extremely close relation there, the Isle of Man is able to boast physical beauty of exceptional charm. The irregular and deeply indented coast adds just so much more to the attractiveness of the resort. Because of this fact stiff winds and storms kick up seas that lash the coast in a way to produce spectacular displays of pounding breakers and flying spray.

The world at large knows the Isle of Man all the better because there it was that the late Sir Hall Caine lived and wrote; and it is upon this selfsame island that the widely heralded Tourist Trophy motor-cycle races are run yearly. These races are but one of the many things done to draw people from afar and are but an expression of civic enterprise. The residents are keenly alive to the fact that their prosperity is contingent upon their efforts to attract outsiders, and nothing within reason is left undone to appeal to the profitable visitor.

Douglas, on the southeast side of the island, is the principal port and the place where most has been done to provide accommodations for visitors. One of our illustrations gives a good idea of the architectural dignity of the community and the substantial way in which habitations overlooking the waterfront have been reared. Because winds are strong and frequent, pounding seas hurl themselves upon the shore. Therefore, piers are of masonry; are built so that they can hold their own against the surging waves; and the promenade paralleling the waterfront is protected in a kindred fashion from stormy seas by a sturdy masonry wall. All these structures have called for fine engineering work; and their construction has required not only resourcefulness but actual courage in meeting some of the physical hazards incident to the undertakings.

Building the new sea wall at Douglas on the Isle of Man.

For some time improvements have been in hand consisting of pier extensions and the widening of the waterfront highway. The latter project is among the more ambitious of these improvements. Broadly stated, it consists in the main of the erection of a new sea wall paralleling the present one 100 feet seaward, and of the construction of a new carriageway, an omnibus track, footways, and a promenade. The new wall will have a length of 1,000 feet, be 26 feet high, and be 11 feet thick at the base and 4 feet thick at the top. The foundation beneath the sea wall will be 14 feet wide. The main body of the wall is to be of massive concrete, and the wearing surface will be formed of precast granolithic face blocks, each

weighing 2 tons. The concrete that is being used is composed of seven parts of beach shingle to one part of Portland cement. The face blocks are of six parts of shingle to one part of rapid-hardening cement, with a 3-inch face made up of three parts of granite chippings and sand to one part of rapid-hardening cement. The fill behind the wall, amounting to 86,000 tons, will be of Manx slate, grit, and clean quarry rubbish. Most of the fill has been obtained, to date, from two municipal quarries on Douglas Head.

The work is going forward at a satisfactory rate because of the fairly extensive use of mechanical equipment in the form of steam cranes, concrete mixers, electrically driven pumps, motor trucks, pile drivers, and flood lights—the latter permitting operations after dark. Owing to the fact that ledge rock lies from 10 to 20 feet below the surface of the existing beach, it was decided to erect the sea wall on a massive concrete foundation having its base from 6 to 7 feet below the beach level, thus avoiding excavating to the underlying rock. This arrangement depends for its security upon the continuance of the beach at its present level. Any action of the sea tending to strip the beach and to undermine the concrete foundation would, of course, imperil the wall. Inasmuch as the foundation lies below the low-water level of spring tides, the site has to be pumped continuously while work is in progress; and electrically driven centrifugal Cameron pumps are employed to do the unwatering.

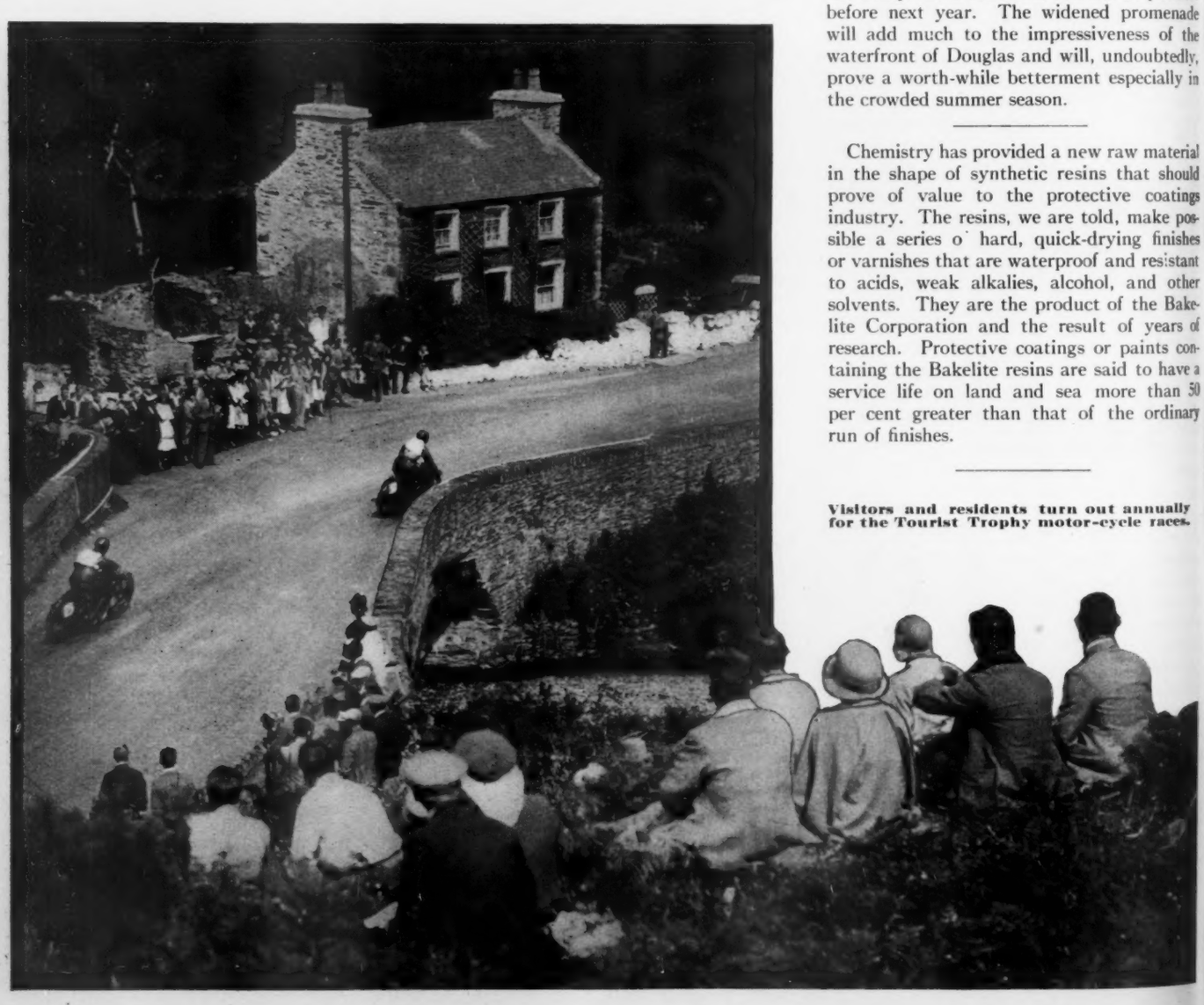
Work on the upper section of the wall has been comparatively simple contrasted with the difficulties encountered in constructing the lower portion. The face blocks are set in place and bolted to the course below until the contiguous concrete backing has hardened sufficiently to withstand the action of the sea. The use of these bolts has prevented damage to newly placed work at times of rough weather, because even a 2-ton block, by itself, will not hold its position against a moderate swell. As sections are completed, the bolt holes, which run continuously from top to bottom of the wall, are grouted up, thus making all joints tight and helping to bind the whole face together.

Inasmuch as operations can be carried on only for about two hours before and two hours after low water in order to make as much progress as possible, it has been necessary to work at every tide. There have, however, been several periods when no work could be done on the foundation owing to the tides and to strong up-channel winds. These winds arrest the outgoing tide, and in this way cause a difference of several feet in the height of the water at low tide.

The quarries from which the rock for the fill behind the sea wall is obtained are also equipped with up-to-date mechanical aids to lighten labor and to promote production. Air-driven rock drills are used, and the blacksmith shop is provided with an Ingersoll-Rand drill-steel sharpener, oil furnace, pedestal grinder, etc. Air for operating the rock drills and the apparatus in the blacksmith shop is furnished by a Type Twenty 10x8-inch portable compressor.

When finished, the widened promenade will be typically modern in all respects; and the driveway will have an asphalt surface on a reinforced-concrete base and be fully equal to all traffic demands likely to be made upon it. Because the project is an "unemployment undertaking", work is carried on only between the first of November and the end of April; and completion, therefore, will not be possible before next year. The widened promenade will add much to the impressiveness of the waterfront of Douglas and will, undoubtedly, prove a worth-while betterment especially in the crowded summer season.

Chemistry has provided a new raw material in the shape of synthetic resins that should prove of value to the protective coatings industry. The resins, we are told, make possible a series o' hard, quick-drying finishes or varnishes that are waterproof and resistant to acids, weak alkalies, alcohol, and other solvents. They are the product of the Bakelite Corporation and the result of years of research. Protective coatings or paints containing the Bakelite resins are said to have a service life on land and sea more than 50 per cent greater than that of the ordinary run of finishes.



Visitors and residents turn out annually for the Tourist Trophy motor-cycle races.

Ingersoll-Rand Sharpeners Do More Than Make Perfect Bits and Shanks on Drill Steel

I-R Drill Steel Sharpener equipped with Shank and Bit Punch

While primarily used for making and sharpening bits and for forming shanks on all kinds and sizes of drill steel, the I-R Drill Steel Sharpener is also a forging machine. It will take care of upsetting, bending and forming and forging operations of all kinds. It is particularly suitable for making bolts, rivets, spikes, pins, wedges, hand picks, etc. In all, over 200 different products have been made on the machine.

Many of these products can be handled on any one of the four sizes of I-R Sharpeners.

An experienced I-R sharpener man will gladly call and make recommendations as to the size of machine best suited for your conditions.

INGERSOLL-RAND CO., 11 Broadway, New York
Branches or distributors in principal cities the world over

Ingersoll-Rand

152-LDS

25732

PRINTED IN U.S.A.

COMPRESSED AIR MAGAZINE

—Founded 1896—

Business and Editorial Offices:
Bowling Green Building, No. 11 Broadway, New York City
Publication Office: Phillipsburg, N. J.

G. W. MORRISON
General Manager and Treasurer

ROBERT G. SKERRETT
Editor

FRANK RICHARDS
Associate Editor

JOSEPH W. SHARP
Secretary

LINWOOD H. GEYER
European Correspondent
147 Leadenhall Street, London, E. C. 4

F. A. McLEAN
Canadian Correspondent
620 Cathcart Street, Montreal, Canada

Contents of This Issue

VOL. XXXVI, No. 10, October, 1931

Articles

Editorials—Our First Families—Why Petain Is Coming—Patented Posies—Present Status of our Merchant Marine.....3600

Santiago de Cuba Engaged on Ambitious Water-Works Project. *E. I. Montoulieu*.....3602

Frozen Pack a Boon to Berry Growers in Pacific Northwest. *Robert S. Gregg*..3607

Burning Glass Source of Heat for Metallurgical Furnace.....3609

Rio Grande Being Made to Irrigate Larger Area in Maverick County. *R. G. Skerrett*.....3610

International Conference on Bituminous Coal.3614

Compressed-Air Unit for Starting Planes....3614

Aircraft Aid Mineral Survey of Barren Lands. *W. M. Goodwin*.....3615

Fully Equipped Roller-Bearing Train Tested..3618

Progress in Drilling Subaqueous Rock. *Charles C. Hansen*.....3620

Pneumatic Lift for Heavy Motor Vehicles....3623

Isle of Man Making Ready for More Visitors..3624

Advertisements

American Air Filter Co..... 15
American Brass Company, The..... 12
American Hammered Piston Ring..... 23
Bucyrus-Erie Company..... 9
Combustion Engineering Corp..... 3
Dayton Rubber Mfg. Company, The..... 11
Direct Separator Company..... 20
Easton Car and Construction Co..... 23
Galland-Henning Manufacturing Co..... 22
General Electric Co..... 18
Goodyear Tire and Rubber Co..... 13
Hercules Powder Company..... 8
Ingersoll-Rand Co.....2–10–16
Jarecki Mfg. Co..... 23
Jewett..... 23
New Jersey Meter Co..... 19
Nicholson & Company, W. H..... 23
Nordberg Mfg. Co..... 20
Rotor Air Tool Company..... 14
Staynew Filter Corp..... 5
Stowe, George M., Jr..... 22
Vacuum Oil Company.....Back Cover
Victaulic Co. of America..... 7
Waukesha Motor Company..... 4
Western Wheeled Scraper Co..... 24
Westinghouse Electric & Mfg. Co..... 17

COMPRESSED AIR MAGAZINE is on file in many public Libraries and is indexed in INDUSTRIAL ARTS INDEX

Sandblast or paint *with the* MULTIBLASTER

Utmost ECONOMY and EFFICIENCY

Lowest first cost with spares and repairs negligible make MULTIBLASTERS a safe buy.

Made in types for ALL purposes.

Shipped Express or Parcels Post on 10 days trial in U. S.

No tanks required. Sand is syphoned from pit, barrel or pile—paint from any container. The MULTIBLASTERS are shipped ready to attach to your air lines.

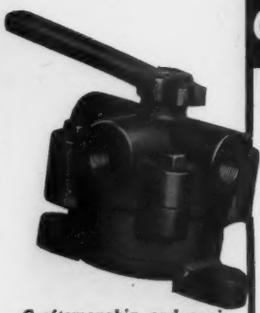
	Price	Wgt.	Hose	Pres.
Standard Blast	$30	8 lbs.	1	90 lbs.
Medium Blast	18	6 lbs.	¾	70 lbs.
Bench Blast	15	3 lbs.	½	50 lbs.
Paint Spray	18	2 lbs.	½	50 lbs.

George M. Stowe, Jr.

Manufacturer Since 1904

69 Forest Avenue, Buffalo, N. Y.

NOPAK VALVES



TIME, power and money saved with NOPAK Valves. For air, water, gas, oil and other fluids.

Will not stick. No contamination of fluids from valve lubricants. Leakless valve seats protected at all times. Discs pressure sealed, whether valve is closed or in operating position. Permits throttling. Easy to operate. No packing. No tapered plugs.

Learn true valve satisfaction with the day you install NOPAKS.

Write for folder.

Craftsmanship and engineering excellence applying a new valve principle tested over seven years assure a more perfect Valve product than ever produced elsewhere. In standard Straightway, 3-Way and 4-Way styles, NOPAK Valves (no packing) made from ¼" to 2" pipe openings. Special sizes and port arrangements on request.

GALLAND-HENNING MANUFACTURING COMPANY
Milwaukee Wis.

Write for facts that have made NOPAKS popular. Ask about FREE test offer.